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TOBACCO MOSAIC AND ITS CONTROL[1]

JOSE R. MONDOÑEDO

Tobacco mosaic has been known since time immemorial. It is possibly the most common and widespread disease of tobacco all over the world. With the great boom in the Virginia tobacco industry in the Philippines these past few years, the disease is becoming a serious problem in the tobacco region.

It is generally accepted that tobacco mosaic entails a loss to the tobacco grower, the degree depending upon the extent of the disease as conditioned by several factors, as inoculation of the plants, environmental conditions, variety of crop, and others. The effect of the disease on yield and quality of tobacco is very well discussed by J. E. McMurtrey, Jr. (1929). He states that when inoculation takes place at transplanting, one may expect a decrease in yield of from 30 to 35 per cent and a decrease in gross value of about 55 per cent.

In the United States tobacco mosaic is known by a variety of names: "calico," "gray top," "mottled top," "mottling," "foxy," "brindle," "mongrel" tobacco, and chlorosis (Allard, 1914; Wolf, 1935).

CAUSAL ORGANISM

There is universal agreement at present that the disease may be due to a virus or a group of viruses presently called *Marmor tabaci* Holmes. It was thought of before as a physiological or functional disorder, but recent investigators have shown that it is parasitic in origin.

The tobacco mosaic virus has long been associated closely with the historical investigations of virus diseases in plants. The disease was first described by Mayer (1886). Iwanowski (1892) showed the transmissibility and filterability of the virus principle. Later Allard (1914) demonstrated the insect transmissibility of the virus.

Mayer (1886) showed that the mosaic virus is killed near a temperature of 176°F. Allard (1914) demonstrated that the filtered sap of a diseased plant is still very infectious after having been kept in a bottle for four months. He also found that dried

[1] General Contribution No. 873.

THE PHILIPPINE AGRICULTURIST, VOL. 39, No. 3, AUGUST, 1955.

ground samples were still highly infectious after 18 months. The virus may be preserved in ether, toluene, or glycerin. In culture media, however, the virus is not known to be able to multiply (Garner, 1950).

Stanley (1937) accomplished the purification of the tobacco mosaic virus. Whether the virus is a crystalline protein or is only associated with such is still a question.

SYMPTOMS

The growth of the virus causes various physiological and chemical changes in the leaves, branches, and sometimes in the flowers of all affected plants. The character and intensity of the symptoms vary greatly, depending upon the age, habits of growth, species and strains of plants affected, and existing external conditions (Dickson, 1947).

Allard (1914) lists the following symptoms as more or less characteristic of the different phases of the disease at one time or another:

(1) Partial or complete chlorosis
(2) Curling of the leaves
(3) Dwarfing and distortion of the leaves
(4) Blistered or "savoyed" appearance of the leaves
(5) Mottling of the leaves with different shades of green
(6) Dwarfing of entire plant
(7) Dwarfing and distortion of the blossoms
(8) Blotched or bleached corollas (in *N. tabacum* only)
(9) Mosaic sucker growth
(10) Death of tissues

The disease presents varied symptoms in young, maturing, and old plants. The strain or kind of causal organism has a lot to do with the symptoms exhibited.

OTHER PLANTS AFFECTED

Allard (1914) reports that several species of the genus Nicotiana, like *N. longiflora, N. silvestris, N. plumbaginifolia, N. rustica,* and *N. paniculata,* are susceptible to the virus. Some species, however, are either immune or highly resistant. Among them are *N. glutinosa, N. glauca,* and *N. viscosum.* Clinton (1909) first proved conclusively that the mosaic disease of tobacco is communicable to tomato plants and vice versa. Allard (1914) successfully trans-

ferred tobacco mosaic to other solanaceous plants: *Lycopersicon, Petunia, Physalis, Datura, Hyoscymus, Solanum,* and *Capsicum.*

DISSEMINATION OF VIRUS

Since the tobacco mosaic virus is widely distributed on the Solanaceae and is able to survive or cause infection even after undergoing adverse conditions, in addition to the fact that it is mechanically transmitted, numerous agencies are obviously responsible for its spread. Its entrance into an area and its spread in that area may be blamed more on man and insects. Of the insects, the aphids are the most notorious (Allard, 1914). Once the virus is established in the field, man, in the course of his field operations such as hoeing, cultivating, topping, and suckering, spreads the virus very fast. Of the different parts of the plant, only the tobacco seed is free from the virus.

CONTROL

Since mosaic is highly infectious and has no known curative measures, control procedures must be directed towards preventing initial infection (Garner, 1950). This implies care in the bringing of planting materials into an area. It is fortunate that tobacco seeds and seedlings from a diseased plant are free from the virus unless inoculated after germination.

Despite precautions to exclude the disease from a district or farm, there is still every possibility that it will enter a farm through avenues beyond control. Good agronomic practices like sanitation, pest control, care in field operations, and crop rotation are indispensable.

Sanitation. Sanitation includes proper disposal of infected or diseased plants and of rubbish from the barn or shed. Rubbish spread in the field provides a good source of inoculum. It is better burned or buried deep.

Proper sterilization of beds, tools, and anything else that may possibly harbor the virus also comes under sanitation. So does removal of weeds suspected of being hosts to the organism.

Control of pests. Allard (1914) demonstrated that by getting rid of the insects, aphids in particular, he saved his cultures from mosaic. Insecticides then are a means of control. Fumigation particularly of the seedbeds is an effective method.

Care in field operations. Plants suspected of being diseased should be gotten rid of right away and properly, particularly during field operations such as transplanting, cultivation, and topping.

Crop rotation. Garner (1950) and Dickson (1947) recommended crop rotation as a means of control. A long-term rotation of three to four years would be more satisfactory since the virus persists in undecomposed plant materials and can withstand winter.

Breeding for resistance. The method of control being exploited at present, the method considered next to the ultimate, is the use of resistant varieties. One big obstacle to this method is the ability and frequency of a strain or kind of virus to mutate. A plant which is resistant now would not be resistant later after a change in the virus has taken place in that direction. Wheat rust, for instance, has several strains or races of the causal organism. The problem is almost purely genetic in nature.

A tremendous amount of work has been done on this phase of tobacco mosaic control. Numerous investigators have tried to tap for commercial use the different sources of mosaic resistance, ranging from the slightly resistant to the completely immune.

Wolf (1935) is doubtful as to whether any species or variety of *Nicotiana* is completely resistant or immune. Khudyan (1940) showed that the 711 varieties of tobacco he worked on varied in susceptibility within themselves but were altogether more susceptible than any of the other 15 different species. He further added that the disease manifests different symptoms on the different varieties.

Partial or complete resistance has been observed in some plants. *N. rustica,* the Ambalema variety of *N. tabacum,* and *N. glutinosa* are the more important ones which are now being used as sources of the resistance factor.

Nicotiana rustica is one of the more promising sources of resistance. The species is thought to derive its necrotic reaction from its *N. undulata* parent, the crosses with *N. tabacum* of which have not been successful. This necrotic type response is due to a dominant gene which was transferred to a strain of *N. paniculata* by repeated crosses and subsequent self-pollination. Holmes (1937a) further carried it to plants in three successive generations of hybrids with *N. tabacum.* Some selfed plants from (*N. rustica* x *N. tabacum*) x *N. tabacum* showed true immunity to mosaic virus without the formation of necrotic spots.

In a field of tobacco in Puerto Rico in 1930, Nolla (1933) observed the almost complete freedom from mosaic of the variety known as Ambalema. Subsequent observations showed that most plants of this variety, when inoculated with the virus of the ordinary tobacco mosaic, did not exhibit any very marked symptoms. A clearing of the virus, however, was noticed in some plants. A smaller percentage exhibited chlorotic areas of a mild type in the internal regions of the blade of the leaf.

Lesions on the leaves are far less on Ambalema than on any other variety, even *N. glutinosa*. Valleau (1935) attributes its resistance to two points:

1. Necrosis-producing strains of the virus appear to be completely localized.

2. The virus is slow to multiply on this variety and is apparently unable to invade the young tissues.

Ambalema is probably the only variety in which complete localization occurs. In all other varieties and species, systemic infection takes place. Valleau further observed that the symptoms expressed by Ambalema are strikingly different from those expressed by its hybrids with other varieties. Leaves of the homozygous resistant parents, even in their young and tender age, rarely, if ever, show necrotic spotting when inoculated with the virus. The F_1 hybrids between nonnecrotic spotting varieties and Ambalema, however, show systemic infection. In other words, the genetic factor controlling necrotic spotting in Ambalema does not prevent systemic infection in such hybrids. Valleau (1942) found that these hybrids exhibit less frequent necrotic spotting.

Studies by Clayton, Smith, and Foster (1938) showed that resistant lines derived from Ambalema and susceptible variety crosses gave a distinct diffuse spotting population. Some of them in the F_3 exhibited mild systemic mottling which, in turn, produced uniform F_4 of this mild or systemic least resistant type.

It may be concluded from the works of Clayton *et al.* and Valleau that two independent pairs of recessive genes are responsible for resistance in Ambalema. There is evidence, however, that modifying genes exist along with these two pairs of genes, which, because they reduce the quality of resistance, present a problem involving frequent backcrossing to the susceptible parent. Also, there seems to be a very close linkage between factors for resistance to tobacco mosaic and factors for susceptibility to sun scald. It may not be a true

linkage since it has never been broken; perhaps it is a pleitropic effect, which makes it more difficult. For this reason, breeders in Maryland seem to have abandoned their resistant strains that have the Ambalema resistance factor.

Holmes (1937b) confirmed the findings of Allard (1914) concerning the existence of a gene resistant to tobacco mosaic in *N. glutinosa* similar to that in *N. rustica*. This gene was carried to three generations of hybrids with *N. tabacum*. The F_1 hybrid showed a necrotic response. Because the F_1 generation was sterile, *N. digluta*, a self-fertile amphidiploid species, had to be used as a bridge to transfer the resistance. Clausen and Goodspeed (1925) described this species which originated from the hybrid *N. glutinosa* ($n = 12$) x *N. tabacum* ($n = 24$). After several trials and backcrosses, a resistant plant similar in almost all characteristics to *N. tabacum* was obtained. Holmes (1938) concluded that resistant lines of commercial varieties can be obtained in a similar manner.

This transfer of inheritance presents a very interesting subject of discussion to many investigators. Many of them are not in complete agreement. Kostoff (1929) believes that it was accomplished by the impartation of the dominant gene for localization with a chromosome segment and not by the substitution or addition of a whole chromosome. His chromosome-segment transference view is based on the hypothesis that the characters would not have likely been maintained if the substitution of an entire chromosome of *N. tabacum* with a chromosome from *N. glutinosa* had taken place.

Gerstel (1943), on the other hand, maintains that the difference between the resistant *N. glutinosa* x *N. tabacum* hybrid and the chlorotic varieties is due to an entire chromosome derived from *N. glutinosa*. He presents some rather interesting evidences in support of his views.

Valleau (1943) thinks conceivable the translocation between the chromosomes of *N. glutinosa* carrying the resistant gene and the corresponding chromosomes in *N. tabacum*. He suggests that they are probably allelomorphs. After several crosses, he obtained ratios similar to those expected if the factors were really carried in homologous chromosomes.

The substitution of the resistant factor from *N. glutinosa* resulted obviously in the transfer of more than just that factor. Valleau (1942), after years of backcrossing, failed to separate some of these linked genes from the resistant factor. McKinney and Clay-

ton (1945) showed conclusively that *N. glutinosa* itself carries a factor for susceptibility to mosaic when grown at higher temperatures. Its hybrids, however, are susceptible at a wider range of temperature because of the genes linked with the resistance factor.

In view of this disadvantage, objections have been raised to the use of *N. glutinosa* especially where high temperatures are common during the growing season (Clayton and McKinney, 1931). The use of Ambalema hybrids with commercial varieties is preferred since the crosses involve only *N. tabacum* chromosomes.

We now have control of resistant factors to tobacco mosaic. What remains to be done is to bring this resistance into commercial use, to transfer them to the commercial varieties without much alteration and loss to the desired type characteristics and market value. In the Maryland tobacco experimental farm some mosaic-resistant Maryland tobacco strains of the glutinosa factor are being tested for commercial use. The results so far look very promising.

Immunization or acquired immunity. As in animals, serological experiments in plants indicate the occurrence of the phenomenon of immunization. As it is not possible to employ injection methods in plants, serum is transferred from one plant to another by grafting. Kostoff (1929) has shown some precipitin reactions in the Nicotiana species similar to the reaction in animals. Immunization is still a new phase of control and remains to be developed if proved possible and practical.

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The specialization of science is an inevitable accompaniment of progress; yet it is full of dangers, and it is cruelly wasteful, since so much that is beautiful and enlightening is cut off from most of the world. This it is proper to the role of the scientist that he not merely find new truth and communicate it to his fellows, but that he teach, that he try to bring the most honest and intelligible account of new knowledge to all who will try to learn.—J. ROBERT OPPENHEIMER.

BODY TEMPERATURE, HEAT TOLERANCE, PULSE AND RESPIRATION RATES OF SANTA GERTRUDIS CATTLE [1]

MIGUEL MANRESA, JR., LITO L. CALO, AND JOSEPH C. MADAMBA [2]

WITH ONE TEXT FIGURE

Preliminary findings indicate that the Santa Gertrudis breed of cattle can adapt itself to the Philippine climate and system of farming.

Morning and afternoon body temperatures during the three-day Iberia Heat Tolerance Test did not differ significantly. Neither did the temperatures taken bimonthly in the early mornings during a three-month period and those taken during the heat tolerance test.

The cows had a heat tolerance index of 86 and the bulls, 88. The differences in pulse and respiration rates for exposure and for animals were insignificant. The 14 cows gained an average of 1.48 pounds a day.

This study on the Santa Gertrudis breed of beef-range cattle newly imported from Texas was undertaken for the purpose of determining the adaptability of the breed to Philippine conditions. The final aim in view is to use this breed as a foundation stock in the formation of a "Philamin" type of beef-range-draft cattle.

Previous studies have shown that hemoglobin content of the blood, body temperature, pulse and respiration rates may be used as guides in selecting cattle adapted to a given set of environmental conditions. Another guide consists of the productivity of cattle in terms of reproduction, growth, milk and beef production. Body temperature, pulse and respiration rates, and gain in weight were observed on Santa Gertrudis cattle[3] during their first year of stay in the Philippines. Data were taken bimonthly in the early mornings for three months and over a three-day Iberia Heat Tolerance Test.

MATERIALS AND METHODS

Fourteen pregnant Santa Gertrudis cows and two bulls, all a little over two years of age and just recently imported into the Philippines from Texas, were used in this experiment. The first batch

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[1] Central Experiment Station Contribution No. 1835.

[2] The authors wish to thank Prof. Burton T. Oñate of the College of Agriculture Statistical Laboratory for advice given and statistical treatment of results.

[3] The Yulo Canlubang Estate in Calamba, Laguna, furnished the animals and facilities for this experiment. The authors particularly wish to thank Mr. Luis A. Yulo for the cooperation he so willingly gave during this research project.

of nine cows had been in Canlubang for about 10 months. A later importation of five cows and two bulls had been in Canlubang for about four months.

The body temperature, pulse rate, and frequency of respiration were taken bimonthly from January to March, 1955. The data were taken early in the morning after the cows had slept in the barn all night. At the end of this trial the animals were subjected to a three-day Iberia Heat Tolerance Test. The test was made on bright sunny days when the atmospheric temperature in the shade was between 90° and 93°F.

The cattle tested for heat tolerance were kept in an open corral where they were free to move about and had access to feed and water (fig. 1). At 10 a.m. and 3 p.m. the animals were led without undue disturbance to the stalls where their rectal temperatures and respira-

Fig. 1.—Santa Gertrudis cattle on Iberia Heat Tolerance Test at Canlubang, Laguna.

tion and pulse rates were obtained. Respiration a minute was observed by counting the movements of the flank. Pulse rate a minute was taken on the coccygeal artery. For respiration and pulse rates the average of three different counts was obtained in the morning and in the afternoon. The animals were returned to the open corral after each set of data had been taken.

The heat tolerance index was computed according to the formula 100 − (10[BT − 101.0]) in which *BT* is the average body temperature obtained under conditions of the test; 101.0 is the normal body temperature of cattle; 10 is a factor to convert degrees of variations in body temperature to a unit basis; and 100 is perfect efficiency in maintaining body temperature at 101.0°F.

The herd was pastured during the rainy season when green grass was available. During the drier months when green pasture was scanty, the animals were kept on pasture and, in addition, were fed corn stover and corncobs spread with molasses at night. No other concentrates were given.

RESULTS AND DISCUSSION

Body temperature. Manresa and Gomez [4] reported the normal body temperature of Indian Nellore cattle as 38.7°C. ± 0.015, the nocturnal body temperature as 38.56°C. ± .013, and the average body temperature as 38.66°C. ± 0.022.

In this study no difference was observed between the morning and afternoon temperatures during the three-day period of the Iberia test (table 1). The value of t required at the 5 per cent level and 26 degrees of freedom (i.e. tabular) was 2.056, and a value of $t = -0.41$ was obtained. During the three-day test the atmospheric temperature in the shade was between 90° and 93°F.

Results of studies by Manresa and Erce [5] showed that in Jersey and Holstein-Friesian cattle the afternoon temperatures were significantly higher than the morning temperatures. The data obtained in the present test indicate that exposure to direct sunlight apparently does not affect the animals to any extent.

The average early morning body temperature taken after the cows had had a night's rest in the shed and before they had roamed around was 102.1° F. for the three-month test (table 2). In the three-day Iberia Heat Tolerance Test, the average body temperature obtained was 102.4°F. Analysis of variance showed no difference for exposure. Tabular F-value under a 5 per cent level was 7.71, whereas the computed F-value was 1.57. Similarly, differences among the animals did not show, the tabular F-value being 6.39 as against the computed F-value of 0.91. That each animal reacted to the environment differently as was expected is shown by the suggestive significant F-value of 2.42 when the F-value required under

[4] M. Manresa and F. Gomez, *Philippine Agriculturist*, **26**, 504 (1937).
[5] M. Manresa and P. P. Erce, *Philippine Agriculturist*, **29**, 452 (1940).

the 5 per cent level was 2.56. It should be pointed out that while individual animals reacted to the environment differently, exposure did not affect the group of animals as a whole.

The normal body temperature of Philippine cows reported by Alcaide[6] was 101.4°F., and by Villegas *et al.*,[7] 101.9°F. The later workers further reported that the body temperature of Jersey, Sahiwal, Red Sindhi, and Brown Swiss cows significantly increased when the animals were transferred from the shade to the sunshine.

What should be compared are not the temperatures of the Philippine and Santa Gertrudis cattle but rather the changes in body temperature because of changes in environment. When such comparisons were made, no significant differences in body temperature were found in the Santa Gertrudis cattle. These results indicate the possibility of the breed's eventually adapting itself to Philippine climatic conditions.

Heat tolerance. The heat tolerance index of the Santa Gertrudis cows as determined by the Iberia Heat Tolerance Test was 86 (table 3). This figure was obtained during a three-day test when the average morning atmospheric temperature at the time the cows were exposed to sunlight was 90°F. and the afternoon temperature in the shade was 92.1°F.

Separate heat tolerance tests were conducted on the first and second shipments of cattle. It is very significant that the heat tolerance index was 86 for the cows of both the first shipment, which had been in the Philippines for 10 months, and the second shipment which had been here for four months. The two bulls of the same age group gave an index of 88. The lower index in cows may be explained by the fact that all of them were pregnant.

Hermosura[8] found the heat tolerance index of Holstein cows in the Alabang Stock Farm to be 71; of Jerseys, 74.1; and of Sahiwals, 84 to 87.

Results of the Iberia Heat Tolerance Test further indicate the ability of the Santa Gertrudis breed to adapt itself to Philippine climatic conditions.

Pulse and respiration rates. Over a three-day heat tolerance test period, the morning and afternoon respiration rates differed in-

[6] A. R. Alcaide, *Philippine Agriculturist*, 34, 41 (1950).

[7] V. Villegas, F. S. Mensalvas, and L. S. Castillo, "A Comparative Study of the Pulse Rate, Frequency of Respiration, and Body Temperature of Holstein, Jersey, Brown Swiss, Red Sindhi, Sahiwal, Nellore, and Philippine Cows in the Shade and in the Sun." (Unpublished notes, 1953).

[8] S. R. Hermosura, *8th Pacific Sci. Cong. Absts.*, 279 (1953).

significantly, but the pulse rates differed significantly (table 1). The difference of 10 or more beats a minute between the morning and afternoon pulse rates may be accounted for by the fact that four cows, numbers 1, 5, 7, and 11, were in an advanced stage of pregnancy. Their added differences possibly swayed the *t*-value to a significant level. If the data for these four animals were excluded, the *t*-value would not be significant.

When the pulse and respiration rates taken bimonthly in the early mornings for three months were compared with those obtained during the Iberia Heat Test period, insignificant differences for exposure and animals were obtained (tables 4 and 5).

Each animal reacted differently to the environment, as expected. Table 4 points out one definitely important relationship between the animals and the change in environment. While there was a significant difference between the morning and afternoon pulse rates during a three-day heat test (table 1), there was no significant difference in pulse rate between exposures and animals. The test was conducted on cows of the same age and stage of pregnancy, as contrasted with the test in which four cows were in an advanced stage of pregnancy.

The mean pulse rate was 80.3 a minute in the three-month wet-season period and 82.7 a minute during the Iberia Heat Test; the mean frequency of respiration was 49.0 a minute in the three-month test and 45.8 a minute in the heat test.

Statistical analyses failed to show any significant difference between the data taken during the colder month and those obtained during the hotter days. Change of environment apparently did not affect the animals as a whole. The results obtained on pulse and respiration rates indicate the possibility of the Santa Gertrudis breed's withstanding the Philippine hot climate.

The data taken in the sun by Villegas *et al.*[9] for pulse and respiration rates were 62.3 a minute and 26.1 a minute, respectively, for native cattle; 62.8 and 78.0 for Brown Swiss; 75.1 and 110.6 for Holsteins; 52.8 and 89.7 for dry Holsteins; 67.3 and 85.6 for milking Jerseys; 56.8 and 33.8 for dry Sahiwals; 78.8 and 35.4 for Red Sindhis.

Hermosura [10] reported the pulse rate of Holsteins as 87 to 87.9 a minute and the respiration rate as 90 to 91.7; the pulse rate of Jerseys as 78.0 to 83.1 and the respiration rate as 85 to 87.9.

[9] Villegas *et al.*, *op. cit.*
[10] Hermosura, *op. cit.*

Gain in weight. During the three-month trial, when the cows had been in the Philippines for 7 to 10 months, body measurements of the cows were taken and their body weights estimated with Morris and Zavoral's [11] formula for cattle:

$$\frac{(\text{Heart girth in inches})^2 \times \text{length in inches}}{300} = \text{weight in pounds}$$

The average daily gain of the 14 cows was 1.48 pounds during the three-month period (table 6). The gains were obtained solely from pasture feed and a scanty supplement of molasses on corncobs and corn stover at night. These data on weight gain further indicate that the Santa Gertrudis breed of cattle has good possibilities for adaptation in the Philippines.

[11] W. E. Morris and H. G. Zavoral, *Univ. of Minn. Agric. Ext. Serv. Ext. Folder*, 70 (1948).

TABLE 1.—*Morning and afternoon readings on body temperature, pulse and respiration rates of Santa Gertrudis cows on a 3-day Iberia Heat Tolerance Test* [a]

COW NO.	DAY OF TEST	BODY TEMPERATURE			PULSE RATE			FREQUENCY OF RESPIRATION		
		a.m.	p.m.	Diff.	a.m.	p.m.	Diff.	a.m.	p.m.	Diff.
		F.	*F.*	*F.*	*F.*	*F.*	*F.*	*F.*	*F.*	*F.*
13	1st day	102.0	102.4	−0.4	87.6	90.0	− 2.4	52.6	48.0	4.6
17		102.7	102.9	−0.2	78.0	84.0	− 6.0	48.0	50.6	− 2.6
7		102.4	102.8	−0.4	90.0	90.0	0	46.6	48.0	− 2.0
5		102.8	103.0	−0.2	90.0	102.0	−12.0	48.0	48.6	− 0.6
3		102.5	102.9	−0.4	78.0	81.6	− 3.6	42.0	48.0	− 6.0
9		103.0	103.0	0	84.0	84.0	0	38.0	56.0	−18.0
11		103.8	102.1	1.7	90.0	90.0	0	52.0	61.0	− 9.3
1		103.4	102.4	1.0	78.0	84.0	− 6.0	46.0	48.0	− 2.0
15		103.8	104.0	−0.2	84.0	90.0	− 6.0	42.0	51.3	− 9.3
13	2nd day	102.0	102.0	0	78.0	84.0	− 6.0	58.0	36.0	22.0
17		102.0	102.4	−0.4	84.0	78.0	6.0	38.0	40.0	− 2.0
7		102.1	102.3	−0.2	78.0	90.0	−12.0	40.0	38.0	2.0
5		102.3	102.0	0.3	78.0	84.0	− 6.0	50.6	51.6	− 1.0
3		103.2	103.4	−0.2	84.0	84.0	0	55.3	46.0	9.3
9		102.3	102.6	−0.3	78.0	78.0	0	42.0	39.3	2.7
11		102.5	102.7	−0.2	78.0	90.0	−12.0	49.3	54.0	− 4.7
1		103.3	102.3	1.0	72.0	84.0	−12.0	42.0	42.0	0
15		102.4	102.6	−0.2	84.0	84.0	0	39.3	46.0	− 6.7
13	3rd day	101.6	102.0	−0.4	72.0	78.0	− 6.0	48.0	48.6	− 0.6
17		101.8	102.5	−0.7	78.0	78.0	0	41.3	48.0	− 6.7
7		101.4	102.0	−0.6	78.0	78.0	0	48.0	46.6	1.4
5		101.5	102.2	−0.7	84.0	78.0	6.0	44.0	42.0	2.0
3		101.8	102.4	−0.6	78.0	78.0	0	57.3	37.3	20.0
9		101.9	102.1	−0.2	84.0	78.0	6.0	38.6	48.0	− 9.4
11		102.0	102.5	−0.5	78.0	84.0	− 6.0	55.3	52.0	3.3
1		102.1	102.7	−0.6	73.8	84.0	−10.2	48.6	36.0	12.6
15		102.6	102.7	−0.1	78.8	81.6	− 2.8	34.0	42.0	− 8.0
Total				−3.7			−91.0			− 9.0
$\bar{x}$				−0.14			− 3.37			− 0.33
$s_{\bar{x}}$				0.34			1.23			1.69
t =				−0.41			− 2.74			− 0.20
				t 05, 26 = 2.056						

[a] Average morning atmospheric temperature in the shade, 90.0°F.; average afternoon atmospheric temperature in the shade, 92.1°F.

TABLE 2.—*Early morning body temperatures taken bimonthly during a 3-month* [a] *period and those taken during a 3-day Iberia Heat Tolerance Test* [b]

ANIMAL NUMBER	3-MONTH BIMONTHLY TEST							
	December		January		February		Total	Mean
	1	2	1	2	1	2		
1	102.0	102.7	101.8	101.8	102.0	103.6	613.9	102.3
2	102.9	102.2	102.6	101.7	101.7	103.5	614.6	102.4
3	102.4	101.7	101.7	102.2	101.8	101.8	611.6	101.9
4	101.5	102.0	101.8	101.5	102.0	102.0	610.8	101.8
5	103.1	102.6	101.8	101.7	101.1	102.6	612.9	102.1
Total	511.9	511.2	509.7	508.9	508.6	513.5	3063.8	102.1

ANIMAL NUMBER	3-DAY IBERIA HEAT TOLERANCE TEST							
	First day		Second day		Third day		Total	Mean
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.		
1	103.5	103.5	102.1	102.7	102.0	102.5	616.3	102.7
2	101.9	102.2	101.6	102.0	101.5	102.1	611.3	101.9
3	102.6	102.7	102.8	102.4	102.2	102.7	615.4	102.6
4	102.7	102.4	102.1	101.8	101.5	102.0	612.5	102.1
5	103.3	103.6	102.1	102.7	102.2	102.4	616.3	102.7
Total	514.0	514.4	510.7	511.6	509.4	511.7	3071.8	102.4

Analysis of variance

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F-VALUE	TABULAR F-VALUE	
					.05	.01
Exposure	1	1.07	1.07	1.57	7.71	21.20
Animal	4	2.50	0.62	0.91	6.39	15.98
Exposure × animal	4	2.73	0.68	2.42	2.56	3.72
Sampling error	50	14.09	0.28			
Total	59	20.39				

[a] Average atmospheric temperature in the shade, 75.0°F.
[b] Average morning atmospheric temperature in the shade, 90.0°F.; average afternoon atmospheric temperature in the shade, 92.1°F.

TABLE 3.—*Results of the 3-day Iberia Heat Tolerance Test on Santa Gertrudis cattle in Canlubang, Laguna* [a]

ITEM	1ST SHIPMENT (10 months in Philippines)	2ND SHIPMENT (4 months in Philippines)	
	Cows	Cows	Bulls
Number of animals	9	5	2
Number of tests	54	30	12
Age of animals, months	24	24	24
Average body temperature, °F.	102.4	102.4	102.2
Iberia Heat Tolerance Index	86.0	86.0	88.0

[a] Average morning atmospheric temperature in the shade, 90.0°F.; average afternoon atmospheric temperature in the shade, 92.1°F.

TABLE 4.—*Early morning pulse rates taken bimonthly during a 3-month* [a] *period and those taken during a 3-day Iberia Heat Tolerance Test* [b]

ANIMAL NUMBER	3-MONTH BIMONTHLY TEST						Total	Mean
	December		January		February			
	1	2	1	2	1	2		
1	78.0	78.0	90.0	84.0	96.0	78.0	504.0	84.0
2	67.8	78.0	80.0	75.6	80.0	74.0	455.4	75.9
3	73.8	79.8	78.0	78.0	84.0	78.0	471.6	78.6
4	78.0	78.0	78.0	84.0	98.0	78.0	494.0	82.3
5	90.0	75.6	84.0	72.0	84.0	78.0	483.6	80.6
Total							2,408.6	80.3

ANIMAL NUMBER	3-DAY IBERIA HEAT TOLERANCE TEST						Total	Mean
	First day		Second day		Third day			
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.		
1	90.0	90.0	90.0	90.0	90.0	90.0	540.0	90.0
2	87.6	78.0	78.0	84.0	72.0	78.0	477.6	79.6
3	78.0	84.0	78.0	84.0	78.0	78.0	480.0	80.0
4	84.0	90.0	84.0	84.0	78.0	78.0	498.0	83.0
5	84.0	78.0	78.0	90.0	84.0	72.0	486.0	81.0
Total							2,481.6	82.7

Analysis of variance

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F-VALUE	TABULAR F-VALUE	
					.05	.01
Exposure	1	88.81	88.81	3.08	7.71	21.20
Animal	4	612.04	153.01	5.31	6.39	15.98
Pooled error	54	1555.35	28.80			
Total	59	2256.20				

[a] Average atmospheric temperature in the shade, 75.0°F.
[b] Average morning atmospheric temperature in the shade, 90.0°F.; average afternoon atmospheric temperature in the shade, 92.1°F.

TABLE 5.—*Early morning respiration rates taken bimonthly during a 3-month* [a] *period and those taken during a 3-day Iberia Heat Tolerance Test* [b]

ANIMAL NUMBER	3-MONTH BIMONTHLY TEST						Total	Mean
	December		January		February			
	1	2	1	2	1	2		
1	43.0	44.6	31.6	40.0	42.0	39.0	240.2	40.0
2	59.0	44.6	48.6	60.6	42.0	52.0	306.8	51.1
3	43.0	36.6	30.6	30.6	68.0	39.0	247.8	41.3
4	58.0	46.0	60.0	58.0	60.0	56.0	338.0	56.3
5	63.0	45.3	57.3	62.0	52.0	58.0	337.6	56.3
Total							1470.4	49.0

ANIMAL NUMBER	3-DAY IBERIA HEAT TOLERANCE TEST						Total	Mean
	First day		Second day		Third day			
	a.m.	p.m	a.m.	p.m.	a.m.	p.m.		
1	42.0	42.0	42.0	48.0	44.0	40.0	258.0	43.0
2	52.0	50.6	44.0	51.6	60.0	46.0	304.2	60.7
3	48.0	40.0	44.0	38.0	46.0	40.0	256.0	42.7
4	43.3	52.6	38.6	46.0	48.0	42.0	270.5	45.1
5	55.3	52.0	44.0	44.0	40.6	48.0	283.9	47.3
Total							1372.6	45.8

Analysis of variance

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F-VALUE	TABULAR F-VALUE	
					.05	.01
Exposure	1	159.41	159.41	1.29	7.71	21.20
Animal	4	1278.61	319.65	2.59	6.39	15.98
Exposure × animal	4	493.16	123.29	2.72	2.56	3.72
Sampling error	50	2267.84	45.36			
Total	59	4199.02				

[a] Average atmospheric temperature in the shade, 75.0°F.
[b] Average morning atmospheric temperature in the shade, 90.0°F.; average afternoon atmospheric temperature in the shade, 92.1°F.

TABLE 6.—*Gain in weight in pounds of 2-year-old Santa Gertrudis cows over a 3-month period* [a]

COW NUMBER	INITIAL WEIGHT (December)	FINAL WEIGHT (March)	GAIN IN WEIGHT
13	1136	1186	50
17	823	975	152
7	988	1066	78
5	741	825	84
3	735	808	73
9	924	1013	89
11	895	1026	131
1	983	1101	118
15	1007	1066	59
P	971	1146	175
20	1013	1097	84
48	971	1097	126
12	1145	1323	178
94	958	1281	323
Total	13290.0	15010.0	1720
Average	949.3	1072.1	122.8
Average of daily gain			1.48

[a] No other feed was given the pastured cows except corncobs and stover spread with molasses at night.

THE INDIVIDUAL PERFORMANCE OF SELECTED S. C. WHITE LEGHORN PULLETS[1]

AMADO C. CAMPOS

On the average, each S. C. White Leghorn pullet laid 207.7 eggs weighing 55.5 grams each during the year. The body weight of the pullets at 10 months averaged 1.42 kilograms. Mortality was only 5.5 per cent. These results indicate that through proper selection and mating, superior birds that can live under local conditions and produce profitably may be isolated from imported ordinary stock of S. C. White Leghorns.

In December, 1946, the Philippine government gave the UP College of Agriculture 400 imported day-old S. C. White Leghorn chicks with which to rehabilitate its badly reduced poultry projects. Since then the Poultry Division of the College has managed to maintain a closed flock of S. C. White Leghorns. Except when three roosters of the Hanson strain were used in 1951, the College S. C. White Leghorn flock has been continuously interbred without the introduction of outside blood.

As facilities for pen mating or individual caging are inadequate, somatic assortative matings have been followed. Under such a system of mating, the best looking males are mated with the phenotypically superior females without regard to their blood relationships. It is likely therefore that some degree of inbreeding has taken place which may have fixed certain distinct economic characters in the College S. C. White Leghorn birds. To find out whether this is true and also to be able to carefully select high-producing birds for possible use in the breeding pen, a group of selected ready-to-lay pullets were caged individually in 1952 and kept under study for one year.

MATERIALS AND METHODS

Seventy-two pullets were legbanded, caged, and assigned individual laying record cards. These birds were picked out from the general flock on the basis of standard-bred qualities and body type. They were kept in three 24-unit Brower individual battery cages inside the Poultry Building. Except for those that died, all the birds remained in their cages until the completion of their first laying

[1] Central Experiment Station Contribution No. 1836.

year. No culling was made on these birds. The usual procedure of managing caged layers was followed. Birds that became sick were not given medication.

The College all-mash laying ration composed of the following ingredients, all parts by weight, was fed to the birds:

Ground corn	50
Fine rice bran	20
Fish meal	20
Copra meal	10

Two pints of cod liver oil and 5 kilograms of ground shells and grit were added to every 100 kilograms of the mash mixture. Chopped green ipil-ipil leaves were supplied to the birds three times a week. Both feed and water were made accessible to them at all times.

RESULTS AND DISCUSSION

Egg production. During the 12-month period, the birds laid a total of 14,661 eggs, which was equivalent to an annual average of 56.9 per cent or 207.7 eggs to each pullet (table 1). Except in December, the monthly production was above 50 per cent. Considering that the birds used in this study were random samples of the kind used in the College breeding pens, the production figures may be considered a fair reflection of the production quality of the College S. C. White Leghorn flock.

Also worth noting is the high monthly percentage production of the birds in spite of the absence of culling. An analysis of their individual production records shows the following distribution of egg production:

NO. OF EGGS PRODUCED	NO. OF BIRDS PRODUCING [a]
Less than 100 eggs	6
100–149	3
150–199	18
200–249	34
250–299	10
300 and above	1

[a] Including birds that died before the 365-day laying period was over.

Of the 68 pullets at the end of the 365-day laying period, 45 were found to have produced 200 eggs or more. Only one laid more than 300 eggs. Bird No. 128 did not lay even a single egg during the whole period of observation. This bird was apparently healthy

and showed external signs of laying, but post-mortem examination showed it to have a diseased ovary.

Mean egg weight. The average weight of all the first 10 eggs laid by each bird every month was 55.5 grams. The lightest egg, produced by hen No. 122, weighed 47.3 grams, and the heaviest, from hen No. 118, weighed 63.3 grams. No direct relationship could be established between the body weight of each layer and the average weight of eggs it produced. Some small birds laid big eggs; the reverse was also true.

The average size, as indicated by weight, of the eggs produced in this study is smaller than the standard 2 ounces to a dozen or 56.7 grams for each egg used by American poultry breeders. But is it necessary that we breed birds for egg size? In an indiscriminating open market, would the expensively produced large-sized eggs have a chance to compete with cheaply produced medium- and small-sized eggs? For the present, it seems to be more advantageous for flock owners to produce medium-sized eggs from layers which need less feed. On the other hand, medium-sized eggs will hatch into medium-sized chicks, resulting in the subsequent reduction of the average size of the birds in the flock.

Body weight. The birds were weighed four months after laying commenced; that is, when they were about 10 months old. They averaged 1.42 kilograms; 11 birds weighed within 200 grams above the average and an equal number weighed within 200 grams below. The lightest pullet weighed 970 grams and the heaviest weighed 2000 grams.

Available figures on other S. C. White Leghorn pullets of the College approximate the weight of the birds used in this study. Compared with newly imported birds of the same breed, the College stock appears to be slightly smaller. For egg production, however, large body size is not a necessity. Average-sized birds that lay average-sized eggs abundantly is the present need of local poultry raisers. One objection to large-sized birds is that they need more feed for maintenance. Also, the number of eggs laid by a pullet is often inversely correlated to body size.

Mortality. It is surprising that only four, or 5.5 per cent, of the 72 pullets died during the one-year observation period. This mortality rate is lower than that obtained from the general flock, probably because a large part of the College's laying flock is kept

as a group in laying pens with access to the yard. In this connection it may be pointed out that all the birds raised by the College are not vaccinated and are not babied. Hence, the inherent capacity of birds to survive adverse conditions is brought to a test. The good environmental conditions of the birds in this study may account for the mortality which was lower than normal.

TABLE 1.—*Monthly distribution of egg production*

MONTH	PERCENTAGE PRODUCTION
April, 1952	54.6
May, 1952	50.8
June, 1952	62.7
July, 1952	64.0
August, 1952	56.9
September, 1952	54.7
October, 1952	53.4
November, 1952	55.2
December, 1952	48.9
January, 1953	58.7
February, 1953	58.4
March, 1953	58.8
Average number of eggs	207.7
Average percentage production	56.9
Total number of eggs produced	14,661

. . . for it is here, in teaching, in the association of scholars, and in the friendships of teachers and taught, of men who by profession must themselves be both teachers and taught, that the narrowness of scientific life can best be moderated, and that the analogies, insights, and harmonies of scientific discovery can find their way into the wider life of man.—J. ROBERT OPPENHEIMER.

INSECTICIDAL TREATMENT OF BAMBOO AGAINST DINODERUS MINUTUS FABR.[1]

GETULIO B. VIADO

WITH ONE TEXT FIGURE

Of the three insecticides tested on splits of *Bambusa vulgaris* Schrad., DDT, followed by BHC, was the most effective against the attack of *D. minutus*. PCP was ineffective, giving results similar to those of the control, in which all the splits were badly infested. Although DDT and BHC did not completely prevent the beetles from damaging the splits, they prevented the beetles from establishing themselves in the splits. The DDT-PCP and BHC-PCP mixtures were less effective in preventing infestation than either DDT or BHC when used alone. No emergence holes, however, were noted in both lots treated with the mixtures. Only PCP had some fungicidal effect on the splits. This effect lasted for only a few months on splits kept from rain and only one month on splits exposed to rain. The lower half of the culms was more susceptible to the borer than the upper half. Practically the same trend of results was exhibited by both the one-year- and two-year-old culms.

The bamboo known locally as "tewanak," *Bambusa vulgaris* Schrad., abounds in many localities in the Philippines. This species, which has no spines and few side shoots at the basal portion of the culm, is relatively easy to harvest. However, it is seldom used because it is very susceptible to the attack of a species of powder-post bettle, *Dinoderus minutus* Fabr., soon after harvest.

Some of the organic insecticides have shown promise against wood- and bamboo-boring insects in other countries. In the Philippines, the preservation of wood and bamboo with insecticides has not been extensively studied. The writer[2] found in 1947 that chairs and stools made of freshly cut mature culms of *B. vulgaris* could be protected from *D. minutus* by DDT solution in kerosene. An orchid house made of slats of *B. vulgaris* sprayed once with 5 per cent DDT in kerosene soon after its construction in 1948 was not attacked by *D. minutus* and remained in use for more than three years until it collapsed in September, 1951, as a result of termite damage on the wooden framework. Cendaña (1940)

[1] Central Experiment Station Contribution No. 1837.
[2] G. B. Viado, *Agricultural-Commercial-Industrial Life*, [4] 11, 8 (1949).

reported a saturated DDT solution in kerosene and a 20 per cent "Neocid" [3] suspension in water as effective against *D. minutus* on structural bamboo.

Only a few references bearing on the control of *Dinoderus* on bamboo in other countries are available. In Puerto Rico, Plank (1947, 1948, 1949) and Plank and Ferrer-Delgado (1949) studied the control of *D. minutus* on bamboo with the use of DDT and other insecticides. Duval (1950) worked on the control of this borer on bamboo in Brazil with oil solutions of chlorinated insecticides.

The object of this study, which was conducted in the Department of Entomology and at Faculty Hill, UP College of Agriculture, from September, 1951, to March, 1954, was to determine the efficacy of DDT, BHC, and PCP in preventing damage by *D. minutus* on splits of freshly cut *B. vulgaris*.

MATERIALS AND METHODS

A large clump of *B. vulgaris* growing on Faculty Hill was selected for this study. In September, 1951, and every month thereafter, young shoots varying in height from 1 to 3 meters were tagged. In September, 1953, two one-year-old culms and two two-year-old culms were cut to 1-meter lengths and numbered. Each section was split into a uniform number of pieces about 1 inch wide. The splits were also numbered. Their edges were cleaned of protruding fibers and the septum on each node was removed.

The splits from one-year-old culms were evenly divided into four or six lots containing the same number of splits from each section. The splits from the two-year-old culms were likewise divided into lots. The treated lots were thoroughly sprayed with the corresponding insecticides with a small plunger hand sprayer. The control lots were sprayed with kerosene alone.

The bundled lots were propped against the outside wall of the laboratory. They were elevated from the ground by a piece of lumber to protect them from ground termites. They were protected from the rain but were exposed to the sun for a limited time in the morning. The holes were counted weekly for 15 weeks. After the first seven or eight weeks of observation, the appearance of emergence holes in some splits made counting of the entrance holes difficult so that up to the end of the test, all the holes in the lots where emergence holes were noted were recorded as emergence holes.

[3] A proprietary insecticide, containing 50 per cent DDT, formulated for use on animals against ectoparasites and marketed by Geigy Co.

The *B. vulgaris* and *B. spinosa* Roxb. culms used in the first test were of unknown age. Those used in subsequent tests were of known age.

The insecticides used consisted of 5 per cent by weight of the technical grade of the chemicals in kerosene. It was necessary to heat the BHC and PCP solutions before using to dissolve whatever crystals had formed on standing. In the first test conducted from November, 1953, to March, 1954, Geigy PCP No. 5 [4] was substituted for the PCP formulation used in the previous tests. This proprietary insecticide was used either alone or in 50-50 mixtures with DDT and BHC.

DISCUSSION OF RESULTS

With but very few exceptions, all the entrance holes were bored on the cut portions of the splits—the ends, sides, and parts of nodes where the septa and side shoots had been removed. Of the more than 1000 splits observed, only two had one entrance hole each on the outer portion or rind and three had one each on the inner side. The beetles were probably attracted to the cut portions of the splits by the characteristic odor. They emerged from all surfaces of the splits, particularly the inner and outer surfaces.

Upon closer examination, an emergence hole may be recognized from an entrance hole. An emergence hole immediately widens into a chamber, but an entrance hole is more or less a uniform tunnel to a certain depth below the surface.

The first test from February to June, 1952, using mature culms, was conducted to determine the relative susceptibility of the two species of bamboo to *D. minutus*. Table 1a shows that *B. vulgaris* is very susceptible to the attack of the beetle. All the control splits of *B. vulgaris* were badly attacked, whereas only seven control splits of *B. spinosa* had one entrance hole each. The average number of entrance holes in the control lot of *B. vulgaris* was 7.4, and that of the emergence holes was 10.9. The control lot of *B. spinosa* had 1.0 entrance and 1.4 emergence holes.

Only 10 of the DDT-treated splits of *B. vulgaris* were attacked. They had an average of 1.3 entrance holes. In the BHC-treated lot, the 24 damaged splits had an average of 1.2 entrance holes. No split in the *B. spinosa* lots treated with DDT and BHC was attacked.

[4] A proprietary product containing 5 per cent pentachlorophenol in aromatic petroleum derivative.

All the 36 splits in the PCP-treated *B. vulgaris* lot, but only six in the *B. spinosa* lot, were attacked.

It is interesting to note that although the DDT- and BHC-treated lots of *B. vulgaris* were attacked, they showed no emergence holes. No emergence holes were also noted on the PCP-treated lot of *B. spinosa.*

Most of the holes in the *B. vulgaris* lots were confined to the lower portion of the culms (table 1b).

One-year-old culms of *B. vulgaris* were tested from September, 1953, to January, 1954 (fig. 1). The lot treated with DDT was attacked by the beetle, but all the holes were only about 1 and 2 millimeters deep. The same condition was noted on the BHC-treated lot, except that this lot had more holes than the DDT lot. However, no emergence holes were noted in both lots after the 15-week period of observation, indicating that the beetles did not bore into the splits deep enough to enable them to oviposit.

The initial attack on the DDT lot was on the third week and the last on the eighth week after treatment (table 2a). The period of susceptibility to beetle attack was therefore six weeks. In the BHC lot, the initial attack was noted on the second week and the last on the tenth week after treatment; the period of susceptibility was nine weeks. Both lots were not infested further up to the time of writing, one year and 10 months after the start of the test.

The PCP and control lots were severely attacked by the borer (fig. 1). In the PCP lot, 31.3 per cent of the splits were attacked on the first week after treatment (table 2a). All the splits were attacked on the third week. The control lot showed 68.8 per cent infestation on the first week and 100 per cent infestation on the second week. Table 2b shows that over 60 per cent of both the entrance and emergence holes were in the lower half of the culms.

In the test of two-year-old culms of *B. vulgaris,* the DDT lot showed shallow holes, which indicated that the beetles were not able to bore deep enough to oviposit (table 3a). Most of the holes were only about 1 millimeter deep. The lot was not attacked until the third week after treatment. The most entrance holes were counted on the fifth week after treatment. The last attack was on the ninth week. Only 20 entrance holes, or 23.8 per cent of the total, were bored within the first four weeks after treatment. No emergence holes were noted. Of the 36 splits used, 63.9 per cent were attacked.

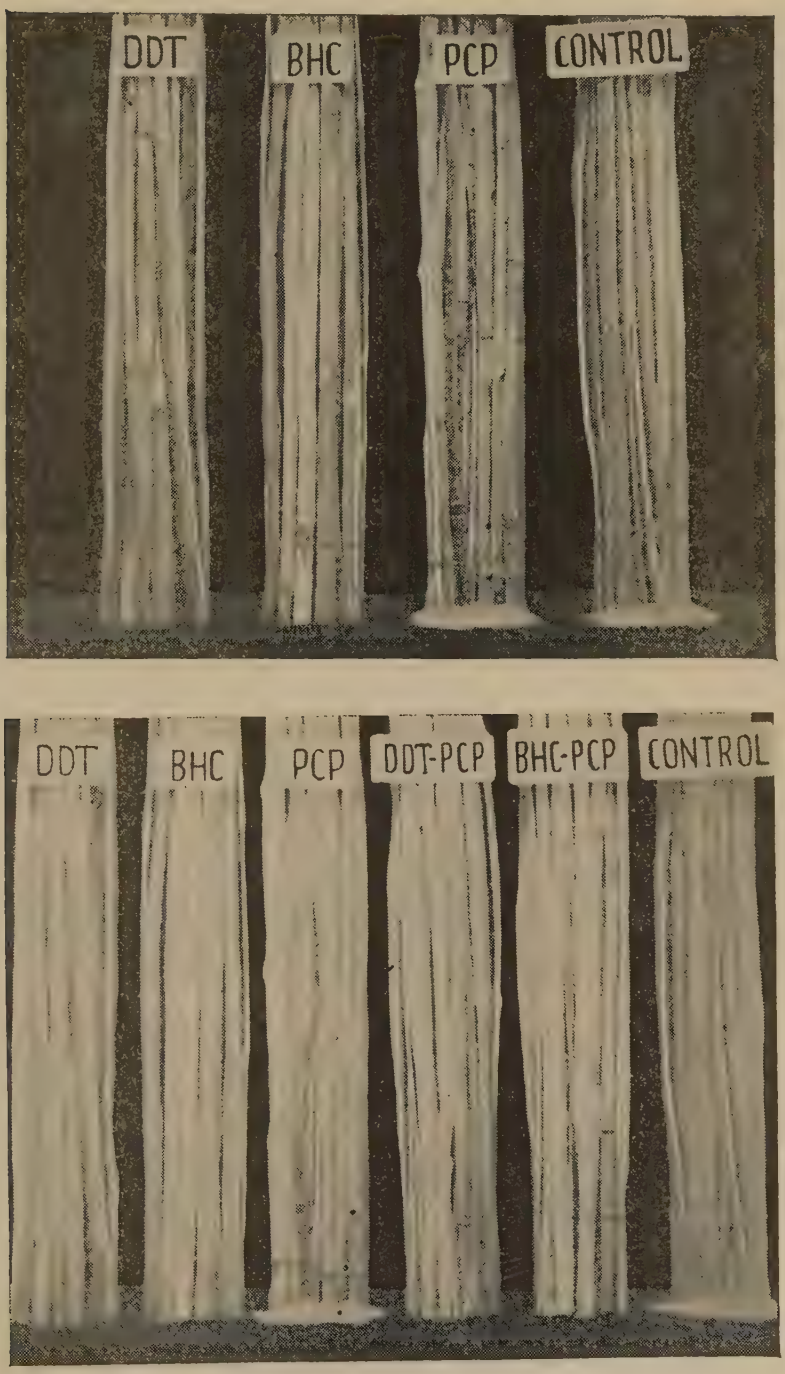

Fig. 1.—Upper panel, bundles of splits variously treated in the second series of tests. Lower panel, bundles of splits variously treated in the third series of tests. Note the accumulated bamboo "dust" or powder at the base of the PCP-treated and control lots as a result of the work of the beetle.

In the lot treated with BHC, 83.3 per cent of the splits were attacked, but as in the DDT-treated lot, all the holes were shallow. Of the total entrance holes, 52.8 per cent were recorded the first four weeks after treatment. No emergence holes were noted. Infestation on this lot was first noted on the second week after treatment. The highest number of entrance holes was noted on the fourth week. The last attack was on the ninth week.

In the PCP lot all the 36 splits were badly attacked. On the first week after treatment, 34 splits had a total of 229 entrance holes, or an average of 6.7 holes in each attacked split. The highest number of holes was recorded on the fourth week when 373 holes, or an average of 10.4 to a split, were noted. Most of the entrance holes (84.5 per cent of the total) were noted within the first four weeks after treatment. On the ninth week, only three entrance holes were observed; on the tenth, emergence holes appeared. The most emergence holes were recorded on the thirteenth week when 564 holes, or an average of 15.5 to a split, were observed.

The control lot was the worst attacked in this test. The beetle started to attack soon after the splits were bundled. The highest number of entrance holes, 11.8 to a split, was noted on the first week when all the splits were attacked. Most of the attacks were confined to the first four weeks after treatment when 86.0 per cent of the total entrance holes were noted. The first emergence holes were noted on the ninth week; the highest weekly reading was taken on the thirteenth week when 538 holes, or an average of 14.9 to a split, were recorded. In all the treatments, more than 50 per cent of the holes were found in the lower half of the culms (table 3b). It is interesting to note that in the PCP-treated lot and in the control, more than four-fifths of the emergence holes were in the lower half of the culms.

Results of the third test conducted from November, 1953, to March, 1954, on one-year-old culms of *B. vulgaris* were similar to those obtained in the second test (table 4a). Five, or 28.8 per cent, of the splits in the DDT-treated lot were attacked, and 7, or 29.2 per cent, in the BHC lot. No emergence holes appeared in either lot. All the splits in the PCP and control lots were attacked, but the former more severely than the latter (fig. 1). The lots treated with DDT-PCP and BHC-PCP mixtures were more susceptible to the borer than the DDT and BHC lots. In the DDT-PCP lot, 45.8 per cent of the splits were injured, and in the BHC-PCP lot, 66.7 per cent. Both lots were also free from emergence holes.

The DDT lot was susceptible to attack during the first five weeks, and the BHC lot during the first six weeks. The DDT-PCP lot was also susceptible during the first five weeks, and the BHC-PCP lot during the first six weeks.

Similar results were obtained when two-year-old culms were tested, except that the PCP-treated lot was more severely attacked than the control lot (table 4b).

DDT was the best of the insecticides tested. Lots treated with DDT and DDT-PCP mixture were not attacked further by the beetle up to the time of writing—three years after the start of the first test, one year and 10 months after the start of the second test, and one year and six months after the start of the third test.

Plank and Ferrer-Delgado (1949) found that both green and partly dried bamboos were protected from powder-post beetle for 12 months after having been dipped for 10 minutes in a 5 per cent solution of DDT. Protection was more permanent on the green than on the partly dried bamboo, a fact which was attributed by the authors to the formation of a more persistent film of DDT on the surface of the green bamboo. Bamboo pieces dipped in the solution were protected from the beetle for 24 months.

In the present tests, 5 per cent DDT solution in kerosene did not give complete protection to the splits. However, the holes were shallow, and apparently the beetles were not able to oviposit in the splits.

Plank (1947) found that one thorough brushing with 5 per cent DDT in kerosene gave 94 per cent control of infestation in freshly harvested, one-year-old culms of *B. vulgaris*. He also observed that most of the holes were shallow. Duval (1950) found that 2.5 to 10 per cent DDT solution brushed on green bamboo pieces gave complete or almost complete protection from *D. minutus*.

Although BHC was inferior to DDT as a preservative against *D. minutus* on bamboo, it prevented the beetles from establishing themselves in the treated splits. Although the percentage infestation of the treated splits was high, the holes were shallow and the beetles were not able to breed in the splits. The splits remained free from further attack more than one year after the start of the tests.

When 0.25 to 3 per cent BHC solution in oil was brushed on pieces of green giant bamboo, Duval (1950) obtained complete or nearly complete control of *D. minutus*. He found both DDT and BHC significantly better than either toxaphene or chlordane.

Pentachlorophenol was the poorest of the three chemicals tested. In the three tests conducted all the treated splits were attacked. Treatment only delayed infestation for a few days. However, infestation was slightly less severe than in the control lots, except among the two-year-old culms on which proprietary PCP preparation (Geigy PCP No. 5) was used.

Plank (1947) found that a saturated solution of pentachlorophenol in kerosene brushed thoroughly on freshly harvested culms of *B. vulgaris* gave 3 per cent control of powder-post beetle. The same author (Plank, 1948) found that dinitro-o-cyclohexylphenol was the only compound which reduced infestation of *D. minutus* on bamboo. Pentachlorophenol, diphenylamine, and kerosene were ineffective.

The control lot, which was treated with kerosene, was badly infested by the beetle. The initial infestation was noted 24 hours after spraying. Splits which were not sprayed were attacked about two hours after the culms had been split and bundled. In some instances, during the process of splitting, beetles were already noted flying around and attacking the uncleaned splits. Kerosene apparently delayed the attack for only a few hours, or only before it evaporated from the splits.

Plank (1948) also found kerosene ineffective in preventing infestation.

Of the three chemicals used, only PCP had some fungicidal effect on bamboo. This effect, however, persisted for only a few months on bamboo splits kept from rain and for only about one month on splits exposed to rain. After that the PCP-treated lots were attacked by the same species of fungi [5] that attacked the control and the other treated lots. The DDT- and BHC-treated lots were as susceptible to the fungi as the control lots.

The first species of the fungus that appeared and which was most common on the splits was a blue mold, *Aspergillus flavus* Link (?). On the treated and untreated lots exposed to rain, *Schizophyllum commune* Fr. was common. After the first few rains a black mold, *Botryodiplodia theobromae* Pat., began to develop on the splits. After about two months of exposure almost all the splits not treated with PCP were stained by the fungus. The splits treated with PCP developed the stain about one month after treatment. This black mold was not found on splits protected from rain.

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[5] All the fungi in this study were identified by Dr. F. T. Orillo of the Department of Plant Pathology.

On some of the PCP-treated splits kept from rain, colonies of a species of *Penicillium* were noted about four months after treatment. Another species of *Penicillium* and a species of *Aspergillus* were noted on the BHC- and DDT-treated splits.

In the course of the experiment three parasites, *Cerocephala dinoderi* Gahan, *Cerocephala aquila* (Girault), and *Platyspathius dinoderi* (Gahan),[6] were reared from splits badly infested with larvae of *D. minutus*. As far as the writer is aware, *C. aquila* has never been reported on *D. minutus* in the Philippines although it has been known to occur in Australia, the Oriental region, and the West Indies. The other two species, *Cerocephala dinoderi* and *Platyspathius dinoderi*, were originally described by Gahan (1925) from specimens collected in Mt. Maquiling, Philippines.

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[6] The first two species (Pteromalidae) were identified by Dr. B. D. Burks, and the last species (Braconidae) by Prof. C. F. W. Muesebeck, both of the US National Museum, from specimens sent through Miss Clare R. Baltazar of the Bureau of Plant Industry, Manila.

Communication received from the US National Museum by Miss Baltazar states that *C. aquila*, originally described as *Proamotura aquila* in A. A. Girault's "New Genera of Chalchid Flies from Australia," *Insecutor Inscitiae Menstruus*, vol. 8, pp. 142-146, 1920, was transferred to *Cerocephala* by A. B. Gahan, in "Review of Some Chalcid Genera," Proceedings US National Museum, vol. 96, p. 361, 1946.

TABLE 1a.—*Efficacy of three insecticides in protecting splits of mature B. vulgaris and B. spinosa from D. minutus*

VARIETY	TREATMENT	NUMBER OF SOUND SPLITS	NUMBER OF DAMAGED SPLITS	ENTRANCE HOLES		EMERGENCE HOLES	
				Total	Average	Total	Average
Bambusa vulgaris	DDT	26	10	13	1.3	0	0
	BHC	12	24	29	1.2	0	0
	PCP	0	36	174	4.8	796	22.1
	Control	0	36	266	7.4	3,937	109.4
Bambusa spinosa	DDT	32	0	0	0	0	0
	BHC	32	0	0	0	0	0
	PCP	26	6	8	1.3	0	0
	Control	25	7	7	1.0	10	1.4

TABLE 1b.—*Distribution of entrance and emergence holes of D. minutus on the various sections of mature culms of B. vulgaris after 15 weeks*

TREATMENT	HOLES	NUMBER OF HOLES IN THE VARIOUS SECTIONS OF THE CULMS									TOTAL NUMBER OF HOLES	TOTAL HOLES IN THE LOWER HALF OF CULMS	
		I	II	III	IV	V	VI	VII	VIII	IX		Number	Per cent
DDT	Entrance	3	1	2	4	0	1	2	0	0	13	10	76.9
	Emergence	0	0	0	0	0	0	0	0	0	0	0	0
BHC	Entrance	5	8	6	3	2	1	1	2	1	29	23	79.3
	Emergence	0	0	0	0	0	0	0	0	0	0	0	0
PCP	Entrance	32	19	27	30	25	16	8	11	6	174	120	69.3
	Emergence	117	139	110	103	86	102	55	63	22	797	512	64.2
Control	Entrance	39	42	45	31	26	27	25	20	11	266	170	63.9
	Emergence	669	363	578	619	446	456	364	255	187	3,937	2,452	62.3

TABLE 2a.—*Efficacy of three insecticides in protecting splits of one-year-old culms of B. vulgaris from D. minutus*

TREATMENT	NUMBER OF SOUND SPLITS	NUMBER OF DAMAGED SPLITS	ENTRANCE HOLES		EMERGENCE HOLES	
			Total	Average	Total	Average
DDT	18	14	31	2.2	0	0
BHC	9	23	59	2.6	0	0
PCP	0	32	435	13.6	482	15.1
Control	0	32	821	25.7	1,064	33.2

TABLE 2b.—*Distribution of entrance and emergence holes of D. minutus on the various sections of one-year-old culms of B. vulgaris after 15 weeks*

TREATMENT	HOLES	NUMBER OF HOLES IN THE VARIOUS SECTIONS OF THE CULMS								TOTAL NUMBER OF HOLES	TOTAL HOLES IN THE LOWER HALF OF CULMS	
		I	II	III	IV	V	VI	VII	VIII		Number	Per cent
DDT	Entrance	6	3	5	7	3	2	4	1	31	21	67.7
	Emergence	0	0	0	0	0	0	0	0	0	0	0
BHC	Entrance	7	13	10	6	7	9	3	4	59	36	61.0
	Emergence	0	0	0	0	0	0	0	0	0	0	0
PCP	Entrance	65	42	66	63	55	48	54	42	435	236	54.3
	Emergence	88	77	94	70	79	32	30	12	482	329	68.3
Control	Entrance	109	152	134	97	125	73	61	70	821	492	59.9
	Emergence	193	150	161	134	156	122	87	61	1,064	638	60.0

TABLE 3a.—*Efficacy of three insecticides in protecting splits of two-year-old culms of B. vulgaris from D. minutus*

TREATMENT	NUMBER OF SOUND SPLITS	NUMBER OF DAMAGED SPLITS	ENTRANCE HOLES		EMERGENCE HOLES	
			Total	Average	Total	Average
DDT	13	23	84	3.7	0	0
BHC	6	30	142	4.7	0	0
PCP	0	36	1,246	34.6	1,645	45.7
Control	0	36	1,640	45.6	2,452	68.1

TABLE 3b.—*Distribution of entrance and emergence holes of D. minutus on the various sections of two-year-old culms of B. vulgaris after 15 weeks*

TREATMENT	HOLES	NUMBER OF HOLES IN THE VARIOUS SECTIONS OF THE CULMS									TOTAL NUMBER OF HOLES	TOTAL HOLES IN THE LOWER HALF OF CULMS	
		I	II	III	IV	V	VI	VII	VIII	IX		Number	Per cent
DDT	Entrance	15	9	10	14	7	5	7	15	2	84	51	60.7
	Emergence	0	0	0	0	0	0	0	0	0	0	0	0
BHC	Entrance	28	37	23	14	16	10	9	1	4	142	110	77.5
	Emergence	0	0	0	0	0	0	0	0	0	0	0	0
PCP	Entrance	206	223	189	154	131	117	106	62	58	1,246	837	67.2
	Emergence	410	175	301	371	191	83	81	10	16	1,638	1,352	82.6
Control	Entrance	183	217	234	239	259	166	172	98	72	1,640	1,002	61.1
	Emergence	471	311	580	432	402	135	57	54	10	2,452	1,995	81.4

TABLE 4a.—*Efficacy of five insecticidal preparations in protecting splits of one-year-old culms of B. vulgaris from D. minutus*

TREATMENT	NUMBER OF SOUND SPLITS	NUMBER OF DAMAGED SPLITS	ENTRANCE HOLES		EMERGENCE HOLES	
			Total	Average	Total	Average
DDT	19	5	6	1.2	0	0
BHC	17	7	15	2.1	0	0
PCP [a]	0	24	275	11.5	51	2.1
DDT–PCP mixture	13	11	36	3.3	0	0
BHC–PCP mixture	8	16	67	4.2	0	0
Control	0	24	321	13.4	154	6.4

[a] Geigy PCP No. 5, a proprietary product.

TABLE 4b.—*Efficacy of five insecticidal preparations in protecting splits of two-year-old culms of B. vulgaris from D. minutus*

TREATMENT	NUMBER OF SOUND SPLITS	NUMBER OF DAMAGED SPLITS	ENTRANCE HOLES		EMERGENCE HOLES	
			Total	Average	Total	Average
DDT	14	10	13	1.3	0	0
BHC	8	16	18	1.1	0	0
PCP [a]	0	24	343	17.1	124	6.2
DDT–PCP mixture	8	16	32	2.0	0	0
BHC–PCP mixture	7	17	67	3.9	0	0
Control	0	24	304	12.7	178	7.4

[a] Geigy PCP No. 5, a proprietary product.

COSTS AND RETURNS OF PALAY PRODUCTION IN ILOILO, 1952–53 [1]

EMILIO U. QUINTANA

Of the 98 farmers interviewed, those in the irrigated areas suffered a net loss of ₱58 per hectare, and those in the nonirrigated areas, ₱25 per hectare. The average yields were only 40 cavans per hectare from the irrigated farms and 32.5 cavans from the nonirrigated ones. The returns could not offset the production costs of ₱421 per hectare on the irrigated farms and ₱330 on the nonirrigated farms.

Information about the costs and returns of palay production will help farmers to increase their incomes and government agencies to formulate better assistance programs. Only with a knowledge of costs and returns can farmers find ways to make their farm businesses more profitable. Government agencies can only fumble without facts.

The costs and returns of producing rice (palay) on the irrigated and nonirrigated lowland farms of Iloilo for the crop year 1952-53 were studied. Ninety-eight rice farmers in two irrigated and two nonirrigated areas were interviewed.

COST OF PRODUCING PALAY PER HECTARE

The average cost of producing palay was ₱421 per hectare on the irrigated farms and ₱329 on the nonirrigated farms (table 1).

Use of land was the largest cost item. The percentage cost was higher in the irrigated areas because of higher land values. The values were ₱2546 for the irrigated land and ₱1645 for the nonirrigated land. Man labor (hired labor, food for hired labor, and unpaid family and operator's labor) was the next highest cost item.

Building costs were higher on the nonirrigated farms because of the high depreciation costs of the houses, which were made of light materials.

The cost of fertilizer was the same in both areas. Ammophos A and B obtained from the Mutual Security Agency were used by nearly all of the rice farmers.

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[1] Central Experiment Station Contribution No. 1838.

TABLE 1.—*Cost per hectare of producing palay*

ITEM OF COST	IRRIGATED		NONIRRIGATED	
	Cost	Per cent	Cost	Per cent
Land use	₱172	41	₱109	33
Man labor	156	38	130	40
Building use	24	6	34	10
Animal labor	20	5	17	5
Fertilizer	13	3	13	4
Irrigation fees	11	2	—	—
Interest on operating cost	10	2	9	3
Seed	9	2	11	3
Tools and equipment	4	1	3	1
Hired hauling to storage	2	[a]	3	1
Containers	—	—	1	[a]
Total	₱421	100	₱330	100

[a] Less than 1.

Seed cost was higher on the nonirrigated farms because the insufficient moisture at sowing time and the consequent low percentage of germination required the use of more seeds.

The charge for tools and equipment included depreciation, interest, and repairs.

Many farmers reported that they did not spend for containers because they had very little palay left after harvest. A large proportion of the palay was paid out for the expenses of the different farm operations.

PHYSICAL LABOR REQUIREMENTS

The man labor days per hectare was 100 days for the irrigated and only 91 days for the nonirrigated farms (table 2). Planting and replanting took more man labor days on the irrigated farms. The operators of the irrigated areas spent several days in replanting because of infestation of armyworms.

The animal days spent in the two areas were about equal, 19 days for the irrigated and 17 days for the nonirrigated farms. Very little animal power was used in hauling palay to the granary or storage. Man power was mostly used.

On the irrigated farms, it took 2.5 man days and 0.5 animal day to produce a cavan of palay, and on the nonirrigated farms, 2.8 man days and 0.5 animal day. In spite of the fewer man and animal days spent per hectare on the nonirrigated farms, fewer days

TABLE 2.—*Average man and animal labor days* [a] *per hectare*

FIELD OPERATION	IRRIGATED		NONIRRIGATED	
	Man labor days	Animal labor days	Man labor days	Animal labor days
Repairing dikes	3	—	4	—
Preparing seedbed	3	3	3	2
Sowing seeds	[b]	—	1	—
Plowing	12	12	11	11
Harrowing	4	4	4	4
Pulling seedlings	9	—	10	—
Planting and replanting	22	—	14	—
Weeding	3	—	9	—
Controlling insects and pests	—	—	[b]	—
Irrigating	5	—	—	—
Fertilizing	[b]	—	1	—
Harvesting, piling and stacking, threshing and cleaning	34	—	31	—
Hauling to granary	2	[b]	2	[b]
Repairing:				
Buildings	2	—	1	—
Tools and equipment	1	—	[b]	—
Total	100	19	91	17
Days per cavan	2.5	.5	2.8	.5

[a] One working day = 8 hours.
[b] Less than 1.

were required to produce a cavan of palay on the irrigated farms because yields per hectare were higher.

COSTS AND RETURNS PER HECTARE

If the farmers of Iloilo had received a fair payment for their time, they would have been producing palay at a loss. The average yield of palay per hectare from the irrigated farms was 40 cavans which, valued at ₱9 a cavan, gave total returns of ₱363. The total cost of production per hectare was ₱421 (table 3). The net loss per hectare was ₱58.

On the nonirrigated farms, the yield per hectare was 32.5 cavans, valued at ₱9.39 a cavan. The total cost of production per hectare was ₱330. The net loss per hectare was ₱25. The crop year 1952-53 was considered a normal year as there had been no unusual climatic disturbances.

Even though the irrigated farms had larger yields and higher returns per hectare than the nonirrigated, they suffered bigger losses

TABLE 3.—*Costs and returns per hectare*

ITEM	IRRIGATED	NONIRRIGATED
Palay to harvester	₱ 55	₱ 47
Palay to landlord	104	47
Palay used as seed	9	11
Palay sold	85	83
Palay used by family	110	117
Total value of palay produced	₱363	₱305
Cost of producing palay	421	330
Net loss	₱ 58	₱ 25

per hectare. Their costs were high enough to more than offset the difference in returns. The charge for irrigation and the higher harvesting expenses because of a bigger crop contributed to the high costs.

COST AND RETURNS PER CAVAN

Operators of the irrigated farms received an average price of ₱9 per cavan; operators of nonirrigated farms received ₱9.39 per cavan (table 4). One factor contributing to the difference in price was the distance from good roads and markets. The irrigated farms studied were far from good roads, but the nonirrigated farms were near good roads leading to towns.

TABLE 4.—*Cost and returns per cavan*

ITEM	IRRIGATED	NONIRRIGATED
Returns per cavan	₱ 9.00	₱ 9.39
Cost per cavan	10.44	10.14
Net loss	₱ 1.44	₱ .75

When the average cost to produce a cavan of palay was subtracted from the returns, the irrigated farms showed an average loss of ₱1.44 per cavan, and the nonirrigated farms, ₱0.75 per cavan.

ACCFA CROP LOANS [1]

Isabel Malabanan Twitchell

Sixty-one per cent of the borrowers were share-tenants, 26 per cent owner-operators, 10 per cent tenant-leasees, and 3 per cent part-owners. All of the farmers raised palay on an average area of 3.7 hectares and had an average yield of 41 cavans per hectare.

The loans ranged from ₱23 to ₱2000. No loan was granted to farmers who did not actually work on the farm. The average loan of ₱154 represented 64 per cent of the ₱239 requested. There was a pronounced tendency for the proportion granted to increase as the size of the request increased. The proportion of the request granted and the amount of the loan granted per unit of produce decreased as the production of a farm increased. As the size of business increased, the proportion of the request granted and the size of the loan decreased. Most of the money borrowed was for productive purposes; however, 22 per cent was for consumption. Most of the borrowers arranged to repay their loans after harvest.

An adequate credit system is needed to sustain continuous production on most farms. Credit facilities have been initiated by government agencies for the improvement of the farmers' economic conditions. In many rural areas these facilities are not known and efforts must be made to make the farmers realize the advantage of obtaining loans from such reputable lenders as these government agencies.

In 1952, the Agricultural Credit and Cooperative Financing Administration was created to extend credit to tenants and small owner-cultivators through their cooperative associations. By December 31, 1953, the ACCFA had progressed, as shown in tables 1 and 2.

After more than two years of operation, it is time to examine the loaning activities of this government-sponsored agency to determine how well it is performing the function of aiding farmers through crop loans.

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[1] Central Experiment Station Contribution No. 1839. Taken from the author's thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1955. Prepared in the Department of Agricultural Economics under the direction of Visiting Professor Chase DelMar Kearl.

TABLE 1.—*Growth of ACCFA cooperatives* [a]

FISCAL YEAR	NUMBER	MEMBERSHIP	AUTHORIZED CAPITAL
1952–1953	22	6,643	₱ 1,305,000
1953–1954	138	49,044	6,508,425
1954–1955 [b]	72	50,256	4,654,975
Total	232	105,943	₱12,468,400

[a] ACCFA 2nd annual report, fiscal year 1953-54.
[b] The first six months only.

TABLE 2.—*Loans granted* [a]

FISCAL YEAR	RELEASED
1952–1953	₱ 227,644.95
1953–1954	3,981,099.15
1954–1955 [b]	14,180,202.49
Total	₱18,388,946.59

[a] ACCFA 2nd annual report, fiscal year 1953-54.
[b] The first six months only.

LOCATION OF THE COOPERATIVES

The farmers' Cooperative Marketing Associations (FACOMAs) studied were in the provinces of Albay, Batangas, Bulacan, Cotabato, Camarines Sur, Iloilo, Isabela, Laguna, Masbate, Nueva Vizcaya, Pangasinan, and Tarlac. The agencies were in towns or districts, whereas the borrowers' farms were in the nearby barrios or sitios.

INFORMATION ON BORROWERS

Of the 200 borrowers studied, the majority, or 61 per cent, were share-tenants, 26 per cent owner-operators, 10 per cent tenant-leasees, and 3 per cent part-owners (table 3). Their ages ranged from 18 to 83 with an average of 40 years. About 86 per cent of the farmers were married.

TABLE 3.—*System under which the land was worked*

SYSTEM	NUMBER	PER CENT
Share tenancy	122	61
Owner operation	52	26
Leasehold tenancy	21	10
Part ownership	5	3
Total	200	100

BUSINESS OF THE BORROWERS

The farmers operated areas ranging from 1 to 20 hectares, with an average of 3.7 hectares. All of the farmers raised palay as their major crop; a few raised coffee or potatoes as minor crops. Of the total land area cultivated by the 200 farmers, 99 per cent was planted to palay. The palay production averaged 153 cavans per farm or 41 cavans per hectare. The tenant's share was approximately 67 per cent of the crop harvested. It ranged from 50 to 92 per cent (table 4).

TABLE 4.—*Crop division of 143 tenants*

RATIO	NUMBER	PER CENT
50–50	62	43
60–40	24	17
70–30	17	12
55–45	16	11
75–25	11	8
67–33	7	5
88–12	3	2
92–8	1	[a]
80–20	1	[a]
52–48	1	[a]
Total	143	100

[a] Less than 1%.

Four farmers who raised an average of 1 hectare of potatoes per farm estimated an average yield of 93 crates per hectare. Two farmers with an average coffee plantation of 2.5 hectares got an average yield of 7 piculs per hectare.

On most farms the tenant shouldered the operating expenses except the land cost (table 5). In a very few cases, however, the landlord and the tenant shared the operating expenses equally. Sometimes the expenses in transplanting or cultivating were also shared.

TABLE 5.—*Sharing of operating expenses*

PERSON	WORK ANIMALS		FARM IMPLEMENTS		PLANTING AND CULTIVATING	
	Number	Per cent	Number	Per cent	Number	Per cent
Tenant	113	79	113	79	92	64
Landlord	4	3	2	1	32	23
None shown	26	18	28	20	19	13
Total	143	100	143	100	143	100

FINANCING OF PREVIOUS YEAR'S CROP

About one-third of the applicants did not indicate where they obtained money for the past crop year, but the others indicated sources that charged an interest of 12 to 80 per cent. For the most part, however, the landlord and tenant helped each other (table 6).

TABLE 6.—*Financial source for previous year's crop*

SOURCE	NUMBER	PER CENT
Landlord	20	10
Landlord and tenant	71	35
Private money lender	31	16
Chinese businessman	3	2
Relatives	2	1
Neighbors	2	1
None shown	71	35
Total	200	100

Not all lenders required the borrowers to pledge property as security, but most of them did. To a businessman who owned a warehouse or a rice mill, the promise of the borrower to deposit his palay with him was often enough security for a loan. This was so in 23 instances. Real estate was pledged in 15 out of 200 cases, and chattels were pledged by 55 farmers (table 7).

TABLE 7.—*Security offered for previous year's crop loan*

SECURITY	NUMBER	PER CENT
Carabao	53	27
Coconut plantation	2	1
Home and home lot	11	6
Farm implements	2	1
Land (field)	2	1
Palay (share)	23	11
Others	36	18
None shown	71	35
Total	200	100

INCOME OUTSIDE AGRICULTURE

Wise lending policy requires that most loans be made on productive activity and that ability to repay be a prime consideration in giving loans. Ability to repay usually is based on the income from production. However, nonagricultural income, to the extent that it is available, can serve as a source of funds for loan repayment.

TABLE 8.—*Average amounts requested and granted and percentage granted in relation to size of loan*

PURPOSE OF LOAN	SIZE OF LOAN									ALL LOANS		
	Below ₱75			₱75-₱149.9			₱150 up					
	Average requested	Average granted	Percentage granted	Average requested	Average granted	Percentage granted	Average requested	Average granted	Percentage granted	Average requested	Average granted	Percentage granted
Preparation of the field ...	₱104	₱20	19	₱ 69	₱ 43	62	₱156	₱100	64	₱109	₱ 55	50
Purchase of seed	58	8	14	34	28	82	82	49	60	58	29	50
Purchase of fertilizers	126	13	10	51	13	25	138	113	82	105	47	45
Planting	64	32	50	77	55	11	135	109	81	68	42	62
Cultivating	33	24	73	58	34	59	112	66	59	69	37	54
Harvesting	63	19	30	42	26	62	103	65	63	94	62	66
Subsistence	63	29	46	91	51	56	126	104	83	92	65	71
Total average	₱136	₱47	35	₱163	₱105	64	₱418	₱307	73	₱239	₱154	64

Forty-nine farmers who had nonagricultural incomes received an average of ₱885 from teaching, doing police work, or running a sari-sari store.

NET WORTH

Although loans are granted primarily on the borrower's ability to repay, lending agencies must have a recourse to cover errors in judgment or adverse conditions which the borrowers cannot foresee. The bank has a duty to the investors and depositors as well as to the borrowers. For this reason, a knowledge of the net worth of the borrowers is essential. A reasonably good net worth is insurance that the bank will be repaid.

Complete data on the net worth of the borrowers could not be gathered, but the indications were that the ratio of net worth to debt was extremely favorable.

SIZE OF LOAN GRANTED

The loans granted ranged from ₱23 to ₱2000. Four farmers who were owner-operators but did not actually work on the farms were not granted loans. The average amount requested was ₱239, but only about two-thirds of it was granted (table 8). The highest percentage of loans granted was for planting. Subsistence loans were next. The lowest percentage granted was for purchase of fertilizers.

Not only was the amount granted to the farmers who asked for small loans less than that given to those asking for larger amounts, the proportion granted was also less. As the amount of the request increased, there was a tendency for the proportion granted to increase. The proportion for the small loans was 35 per cent; it was 73 per cent for larger loans.

RELATIONSHIP OF PRODUCTION TO AMOUNT OF LOAN GRANTED

Very little relationship was found between productive capacity and the proportion loaned and other factors. Farmers with fairly large production capacity were given only about the same proportion of their request as those with low total production. Farmers producing 90 cavans of palay and below were given one-half of the amount they requested (table 9). Their requests for planting and subsistence loans, however, were granted in the proportion of two-thirds of the amount requested. The over-all average was 64 per cent. Farmers producing 90 to 135 cavans of palay were granted about two-thirds of their requests. Farmers producing more than

TABLE 9.—*Percentage granted of the average loan requested in relation to production capacity*

PURPOSE OF LOAN	ESTIMATED CROP								
	Below 90 cavans			90-135.9 cavans			136 cavans up		
	Average requested	Average granted	Percentage granted	Average requested	Average granted	Percentage granted	Average requested	Average granted	Percentage granted
Preparation of the field	₱ 64	₱34	53	₱ 84	₱ 57	68	₱161	₱ 71	44
Purchase of seed	32	16	50	39	29	74	103	41	40
Purchase of fertilizers	34	19	56	99	57	58	165	102	63
Planting	53	38	72	78	59	76	140	101	72
Cultivating	27	16	59	74	48	65	111	63	57
Harvesting	45	23	51	57	33	58	94	48	51
Subsistence	67	46	69	84	53	63	140	99	71
All farms	₱112	₱72	64	₱177	₱121	68	₱422	₱262	62

TABLE 10.—*Percentage granted of the average loan requested in relation to size of farm*

PURPOSE OF LOAN	SIZE OF FARM								
	Below 2.5 hectares			2.5-3.5 hectares			3.6 hectares up		
	Average requested	Average granted	Percentage granted	Average requested	Average granted	Percentage granted	Average requested	Average granted	Percentage granted
Preparation of the field	₱ 63	₱42	67	₱ 98	₱ 49	50	₱167	₱107	64
Purchase of seed	26	19	73	58	34	59	94	47	50
Purchase of fertilizers	43	23	53	85	54	64	172	103	60
Planting	58	39	67	76	55	72	145	116	80
Cultivating	18	9	50	76	51	67	113	73	65
Harvesting	41	27	66	53	34	64	108	68	63
Subsistence	73	45	62	81	46	57	133	93	70
All farms	₱120	₱77	64	₱200	₱123	62	₱409	₱257	63

136 cavans were granted very little for preparing the field and for purchase of seed but were granted loans for subsistence in nearly the same amount as for planting. The over-all average for this group was 62 per cent. These farmers with higher production capacity and, hence, greater repayment potential were granted a smaller proportion of their requests than those producing less number of cavans.

The amount of the loans per cavan of rice produced averaged ₱1.28 for the farms with small production, ₱1.07 for the medium-producing farms, and ₱.90 for the high-producing farms. From farmers with high production capacity, a lending agency can expect a considerably higher proportion of the production to be available for debt payment than from farmers with low production capacity. ACCFA apparently does not take this into consideration in its lending.

RELATIONSHIP OF SIZE OF FARM TO AMOUNT OF LOAN GRANTED

Generally, farmers with larger businesses are better loan risks than those with small ones. The larger businesses in themselves are an indication of the better business ability of the operators. Besides, there is likely to be more money available for debt service from a large farm than from a small one.

Farmers cultivating 2.5 hectares were granted about two-thirds of their requests other than those for cultivating and for purchase of fertilizers (table 10). One-half of the amount requested for preparing the field and about two-thirds for other purposes were granted to farmers who cultivated 2.5 to 3.5 hectares. Farmers who operated more than 3.5 hectares were granted about two-thirds of the amount they requested, or an average of ₱257 out of ₱409, except on the loans for the purchase of seed.

The loans on the small farms averaged ₱44.25 per hectare. For the medium-sized group the average was ₱44.09. The larger farms averaged ₱37.30 per hectare. Again ACCFA apparently does not consider size of farm as it may affect ability to pay.

PURPOSE OF LOANS GRANTED

The 200 farmers indicated the specific items for which money borrowed would be used. The principal purpose was for production expenses (table 11). However, 112 farmers requested loans for subsistence.

TABLE 11.—*Purpose of loans*

PURPOSE OF LOAN	NUMBER	PER CENT
Preparation of the field	75	15
Purchase of seed	56	11
Purchase of fertilizers	38	8
Planting	143	28
Cultivating	25	5
Harvesting	57	11
Subsistence	112	22
Total	506	100

From a strictly business point of view farmer loans for consumption purposes are not sound. Loans for productive purposes can be expected to be repaid out of production. Consumption loans do not in themselves have a basis for repayment.

Mabbun [3] suggested that to minimize the temptation to use credit for purely consumption purposes and to emphasize the importance of using borrowed funds for agriculture, the agency should grant loans to farmers only at certain periods during the year.

SECURITY AND PAYMENT OF LOANS

ACCFA did not require any security since the farmers were economically too weak to meet the banking security standards. Production itself was the only type of security which could be required.

The borrowers promised to pay at times convenient for their businesses (table 12). Two-thirds elected to pay from January through March.

TABLE 12.—*Repayment of loans granted to 200 farmers*

DATE	NUMBER	PER CENT
January, 1954	23	11
February, 1954	66	33
March, 1954	44	22
After harvest	24	12
Other dates later	24	12
None shown	19	10
Total	200	100

[3] P. N. Mabbun, *Philippine Agriculturist*, 37, 493 (1936).

THE PHOTOPERIODIC RESPONSE OF ELON-ELON RICE [1]

J. R. Velasco and F. C. Manuel

WITH FIVE TEXT FIGURES

The experiments show that the Elon-elon variety of rice is a short-day plant capable of flowering only from November to March under natural conditions, regardless of the month of planting. The stage of ripeness-to-flower in this variety was apparently attained at about 15 days of age. The older the plant, however, the less short-day cycles were needed to initiate the flower buds. A shift from the short-day to the long-day treatment after flower-bud initiation delayed flower emergence. Short days, therefore, are needed in flower-bud initiation and flower-bud development. The number of day-and-night cycles until flowering varied with the different day-lengths. Both very long and very short days delayed flowering. The optimum day-length was 8 to 10 hours. Physiologically active compounds used in this study did not seem to affect flowering.

The importance of the relation between light and plant development has long been recognized. Knowledge acquired in studies on this relationship has found practical application in plant breeding, in timing the sowing of crops, and in plant introduction.

Although the phenomenon called photoperiodism in plants has been known for almost 40 years, the mechanism through which it expresses itself is still unknown. Attempts at extracting the flowering stimulus and finding a chemical which will duplicate the effect of the photoperiod have resulted in many unconfirmed claims of success. Several suggestions have been advanced as to the possible metabolic changes effected by a definite length of day, but up to the present time, none of these suggestions has gained general recognition. The fact that the work is very fascinating, however, has attracted more and more workers to it.

In the Philippines, Oñate and Espino (1948) observed no effect of day-length on the flowering of Inintiw, an upland variety of rice.

In India, Ghose and Shasty (1954) found that the flowering duration of Elon-elon under short-day treatment was shortest when the variety was planted in June (65.8 days) and longest when it was

[1] Central Experiment Station Contribution No. 1840. This paper includes the data in the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1955.

planted in November (91.3 days). They also observed that the later the variety or type, the greater was its response to photoperiod.

The present study attempts to find more information on the effect of photoperiod on the development of the Elon-elon variety of rice.

MATERIALS AND METHODS

Elon-elon rice plants were grown in earthen pots of about 20 centimeters in diameter. The pots contained about 3 kilograms of air-dried Lipa clay loam soil pulverized to pass a 1-centimeter mesh. The plants were grown in the yard where they were exposed to natural day-length and other environmental conditions until they were ready for the artificial day-length treatment.

For a dark chamber, a wire cage, 8 feet cube, was covered by a gunny sack painted black with Chinese ink. Plants in a 10-hour day (short day) experiment were placed in this chamber at 4:00 p.m. and taken out at 6 a.m.

For a long-day treatment, the normal 12-hour day was supplemented with three hours of incandescent light. Seventy-five-watt bulbs strung about 1 foot above the plants were lighted from 6:00 to 9:00 p.m. One bulb was allowed to every three potted plants.

EXPERIMENTS AND RESULTS

Preliminary experiments. To find how Elon-elon rice plants would behave at different seasons of the year, seeds were planted in different months. The planting dates were chosen at random, but most of the months of the year were represented.

The Elon-elon plants flowered only in November, December, January, February, and March, months which have short days (table 1). These months are also the coolest period of the year, but for the present only day-length as a factor of development was studied.

Of the 1951 cultures, the October and November seedlings seemed to mature earliest. They took about 100 days to flower after seeding (table 1). Probably because of a slight change in climatic conditions, the January planting in 1953 matured even earlier. It took 75 days to flower after seeding. The February planting took 281 days to flower. This lot went through the long-day season and the hottest months of the year.

In the light of these indications, it was thought of interest to find out if different lengths of day would affect the plants differ-

TABLE 1.—*Age at flowering of Elon-elon rice plants planted in different months of the year*

DATE PLANTED	DATE FLOWERED	AGE AT FLOWER EMERGENCE
		days
June 15, 1951	November 20, 1951	158
September 7, 1951	December 30, 1951	114
October 1, 1951	January 8, 1952	99
November 12, 1951	February 21, 1952	101
November 20, 1951	March 11, 1952	111
January 12, 1953	March 26, 1953	75
February 4, 1954	November 4, 1954	281
April 1, 1953	November 13, 1953	225

ently. Eighteen pots were planted to Elon-elon on December 30, 1953. Three to four seeds were planted to a hill and two hills to a pot. When the plants were 5 centimeters tall, they were thinned down to one plant to a hill. They were then fertilized with ammonium sulfate at the rate of 2½ grams to a pot or a computed rate of 975 kg./ha.

The plants were kept under natural day-length and typical lowland conditions until they were 45 days old. They then were divided into three cultures of six pots each. Culture I was exposed to sunlight from 6 a.m. to 6 p.m. (12-hour day); culture II was exposed to sunlight from 9 a.m. to 5 p.m. (8-hour day); and culture III was exposed to 12 hours of daylight and to incandescent light from 6 p.m. to 9 p.m. (15-hour day). To follow flower-bud initiation and development, microscopic sections of the shoot apices were prepared every five days.

One week after the start of the photoperiodic treatment, culture II showed distinct flower-bud initiation (table 2). The dome-shaped apex had tuberclelike protuberances at its sides, suggesting that it was in a fairly advanced stage. On the other hand, cultures I and III still retained the pyramidal apex without protuberances characteristic of the vegetative condition.

After four weeks of photoperiodic treatment, when the plants were 75 days old, flower-bud initiation was noted in culture I. It should be mentioned at this point that the normal day in February and March which was assumed to have 12 hours of light has actually about 11 hours of light only. This shorter light period probably caused flower induction in culture I.

A modification in the experiment was introduced after flower-bud initiation in culture II. Three pots were returned to the normal

TABLE 2.—*Effect of different lengths of light period on flowering* [a]

CULTURE NUMBER	PERIOD OF LIGHT EXPOSURE	NUMBER OF HOURS OF EXPOSURE	NUMBER OF DAYS FROM PLANTING TO	
			Floral-bud initiation	Floral emergence
I	Natural daylight 6:00 a.m.–6:00 p.m.	12	78	116
II	Natural daylight 9:00 a.m.–5:00 p.m.	8	54	75
III	Natural daylight + 3 hours artificial illumination	15	280	316

[a] Plants were exposed to different photoperiods at 45 days of age.

day while three others remained in the short-day treatment. The object was to determine the effect of length of day on the development of the flower-bud until emergence.

It will be noted in figure 1 that the flowers of the plants under continuous short-day treatment emerged earlier than those of the plants that were returned to the normal day.

Stage of ripeness-to-flower. Knowledge of the age at which the plant is receptive to light treatment saves the experimenter time and effort. Gregory (1948) cited Klebs as having divided flowering into three stages: (1) stage of ripeness-to-flower, (2) stage of flower initiation, and (3) stage of bud development and ultimate opening.

In order to determine the stage of ripeness-to-flower, the stage when the plant is receptive to photoperiodic treatment, 70 pots were prepared and planted on February 23, 1954. The plants were thinned to one to each pot when they were 5 centimeters tall. On March 25, they were fertilized with ammonium sulfate at 1 gram to a pot.

The lots were divided into seven lots of 10 pots each. Lot I was subjected to 10-hour day treatment from germination until the flower emerged. Lot II was exposed at 15 days of age, lot III at 30 days, lot IV at 45 days, lot V at 60 days, and lot VI at 60 days. Lot VII was not subjected to short-day treatment at all. Microscopic examination was made of the shoot apices of the plants on April 15 and every two days thereafter.

The first microscopic sections, taken when the plants were 45 days old, showed that the flower bud in lot I was in an advanced stage (table 3). The flower emerged less than two weeks later. Lot II showed the flower bud in a less advanced stage of develop-

ment. The flower emerged 15 days later or 45 days after the start of short-day treatment. Lot III was still vegetative and so was the control (lot VII). Lot III showed flower-bud initiation 23 days after the start of short-day treatment.

TABLE 3.—*Effect of age at short-day treatment on flowering*

LOT NUMBER	AGE AT SHORT-DAY TREATMENT	LENGTH OF SHORT-DAY TREATMENT UNTIL		AVERAGE AGE AT FLORAL EMERGENCE
		Floral-bud initiation	Floral emergence	
I	0	45 [a]	58	58
II	15	30	45	60
III	30	23	41	71
IVa	45	13	49 [b]	84
IVb	45	13	13 [c]	94
V	60	6	6	131 [d]
VI	60	6	32	126
VII	—	—	—	249

[a] When the first dissection was made, the flower buds were well-developed. They must have differentiated much earlier.

[b] Short-day treatment continued until flower emergence.

[c] Short-day treatment stopped after 13 cycles when flower-bud differentiation was noted.

[d] Lots V and VI showed flower-bud differentiation after 8 short-day cycles; however, they seemed to revert to the vegetative condition 34 days later, or at the age of 100 days. At this point, lot VI was resubjected to short-day treatment for 26 days, at the end of which time the flower emerged. Flower-bud differentiation was again noticed on the third day after restoration to short-day treatment.

That lots I and II flowered at practically the same age is one evidence that the stage of ripeness-to-flower is at about the age of 15 days. Probably, the short-day treatment from germination to 15 days of age in lot I did not influence the plant.

It will be noted that as the plants increased in age at the start of the short-day treatment, progressively less cycles were needed to initiate the flower bud. At 60 days, only six cycles were sufficient to elicit the change.

Effect of number of short days on flower emergence. The difference in stage of development between the plants in the uninterrupted 8-hour day treatment and those in the interrupted 8-hour day treatment (fig. 1) suggested that photoperiod affects flower-bud development. This was confirmed by the difference between lots IVa and IVb in table 3. When the short-day treatment was stopped as soon as flower-bud initiation had been noted, flower emergence was delayed about 10 days (lot IVb).

Fig. 1.—Plants in different day-lengths. From right to left, plants exposed to 33 days of 15-hour light; to 30 days of 12-hour light; to 9 days of 8-hour light followed by 21 days of 12-hour light; to 30 days of uninterrupted 8-hour light. (*Photograph taken by Photographic Division*).

To find the minimum number of cycles that can induce flowering, 80 pots were planted on May 21, 1954. Only one plant was maintained in each pot. The plants were kept under lowland conditions. On June 14, they were fertilized with ammonium sulfate at 1 gram to a plant (390 kg./ha.). On July 24, seven lots consisting of 10 pots each were given 10-hour light by placing them inside the dark chamber at 4 p.m. and taking them out at 6 a.m. Lot I was given this treatment for 5 days; lot II, 10 days; lot III, 15 days; lot IV, 20 days; lot V, 25 days; lot VI, 30 days; and lot VII, 35 days. Lot VIII was not given any short-day treatment at all.

The shoot apex of lot I was examined every day for six days, starting with the short-day treatment. Subsequent examinations were done weekly in all lots. Camera lucida drawings were made of the shoot apices whenever there were changes thaat were thought to be of interest (figs. 2-5).

Flower-bud initiation was noted in all lots after six days of short-day treatment (table 4). This was on July 29 when the plants were 5 days old. Lot I was transferred to the normal-day treatment, which was fairly long. It was noted that the flower bud did not develop further. In the third examination two weeks later, the flower bud had reverted to the vegetative condition (fig. 2). This lot flowered on November 8, or about 167 days after germination. The control (lot VIII), which did not receive the short-day treatment, flowered in 168 days, or practically at the same time as lot I.

TABLE 4.—*Effect of number of cycles of short days on flower emergence*

LOT	AGE AT SHORT-DAY TREATMENT	LENGTH OF SHORT-DAY TREATMENT FOR		AGE AT FLORAL EMERGENCE
		Floral-bud initiation	Floral emergence	
I	60	5	5	167
II	60	5	10	166
III	60	5	15	135
IV	60	5	20	118
V	60	5	25	112
VI	60	5	30	111
VII	60	5	35	107
VIII	Control	—	—	168

Lot II had flower buds whose development remained almost at a standstill for some time (figs. 2-4). It flowered in 166 days. Apparently, even 10 days of short-day treatment in July did not appreciably change the age at flowering of this variety.

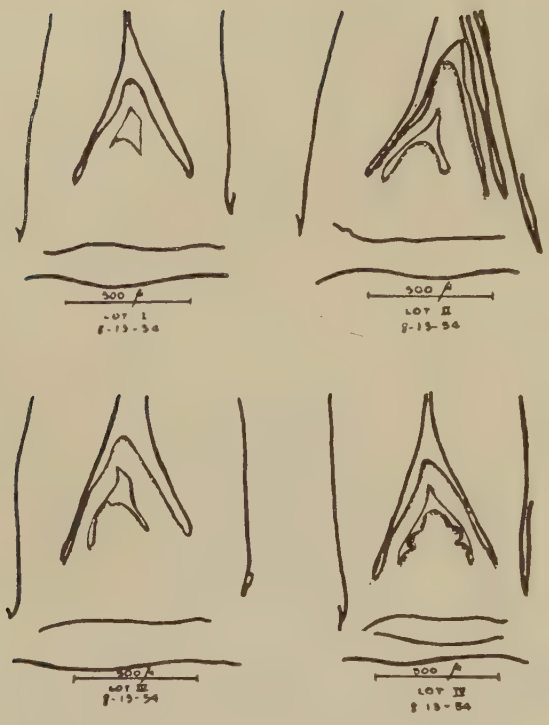

Fig. 2.—Camera lucida drawings of the shoot apices of plants from the different lots showing the progress of floral-bud initiation on August 13, 1954. Lot I, reverted to the vegetative condition; lot II, flower bud reverting to vegetative condition; lot III, with floral primordia; lot IV, with floral primordia in a more advanced stage of development. Lots V, VI, and VII were in the same stage of development as lot IV. Lot VIII was vegetative like lot I.

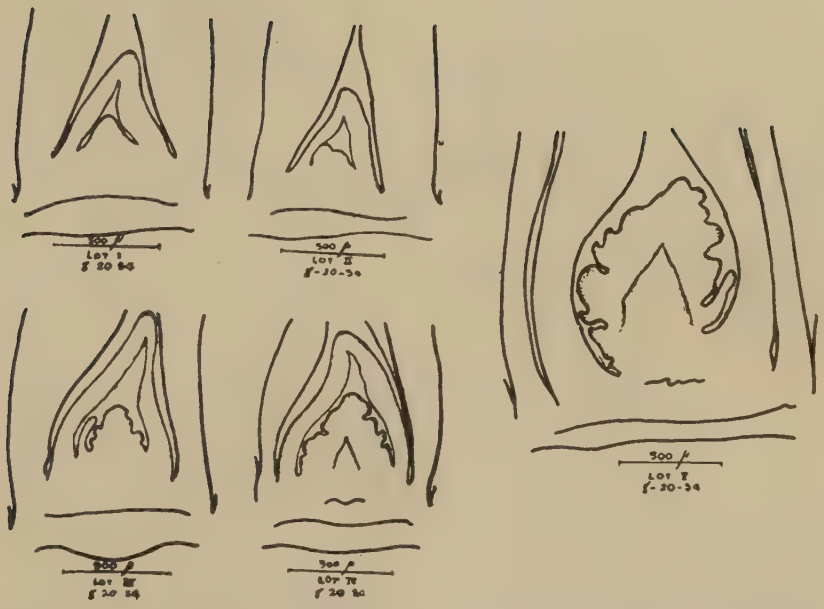

Fig. 3.—Camera lucida drawings of the shoot apices showing progress of floral-bud initiation and differentiation on August 20, 1954. Lot I, vegetative; lot II, flower bud in an early stage; lot III, with a floral bud in an advanced stage; lot IV, with a much more advanced flower-bud development; lot V, with a flower bud already differentiating into an inflorescence. Lots VI and VII had the same stage of flower development as lot V. Lot VIII was vegetative like lot I.

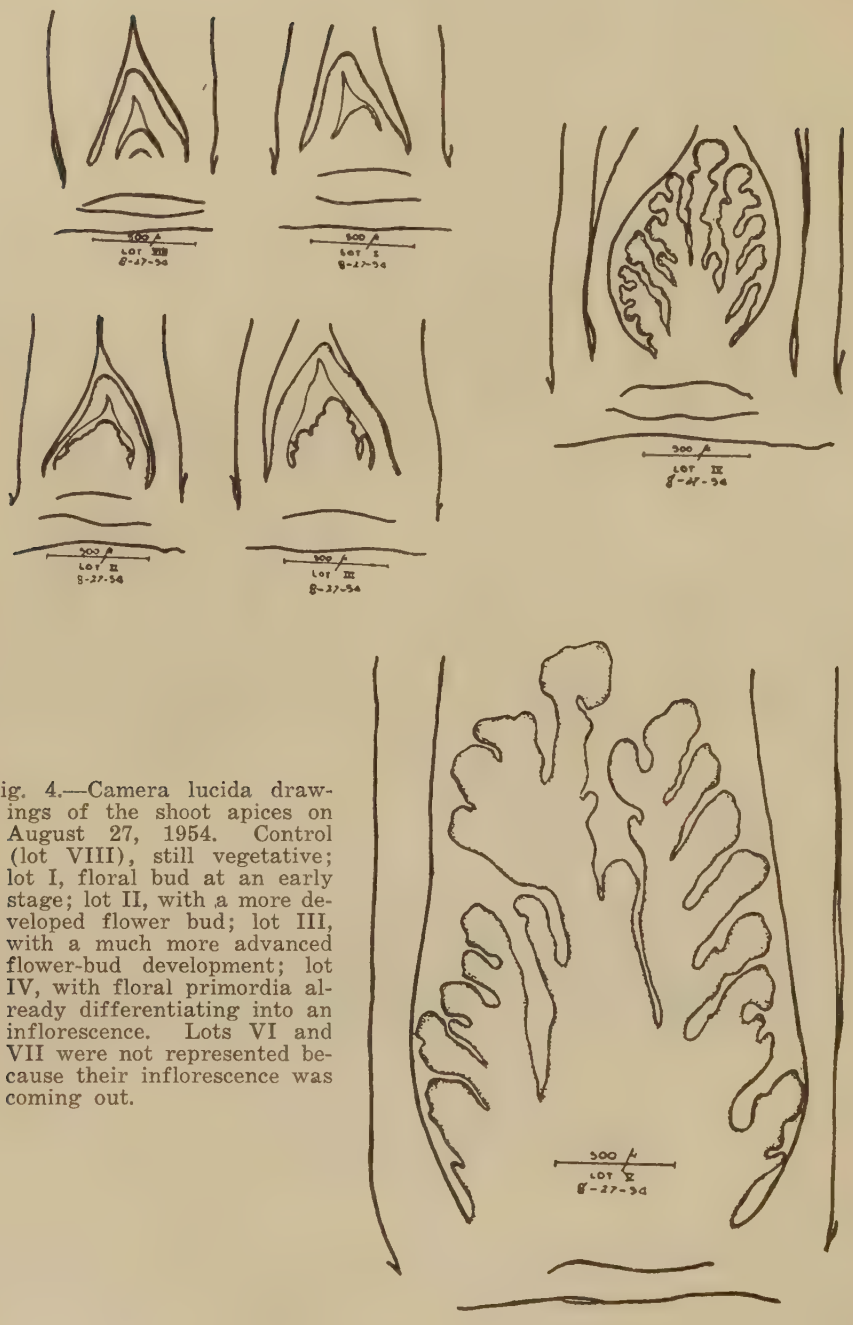

Fig. 4.—Camera lucida drawings of the shoot apices on August 27, 1954. Control (lot VIII), still vegetative; lot I, floral bud at an early stage; lot II, with a more developed flower bud; lot III, with a much more advanced flower-bud development; lot IV, with floral primordia already differentiating into an inflorescence. Lots VI and VII were not represented because their inflorescence was coming out.

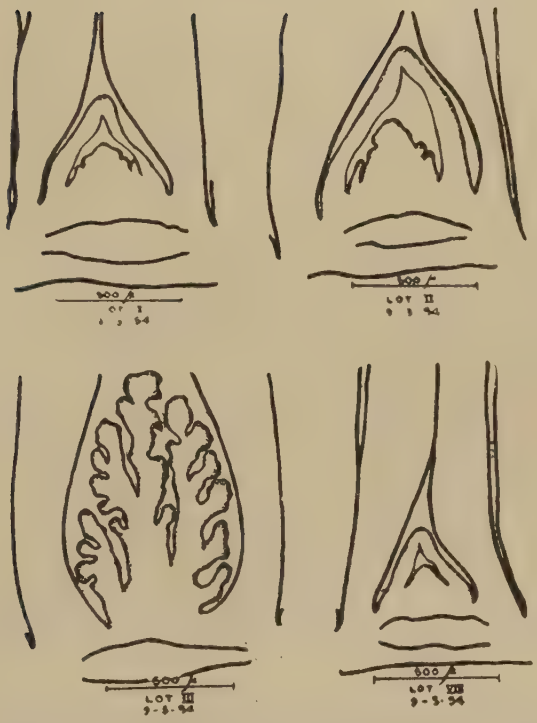

Fig. 5.—Camera lucida drawings of the shoot apices on September 3, 1954. Control (lot VIII), still vegetative; lot I, with well-developed floral primordia; lot II, with a much more advanced flower-bud development; lot III, with an already differentiated flower bud. Lots IV and V were not represented because their inflorescence was already very big and ready to emerge.

In lot III development was very slow. The flower emerged in 135 days, or one month earlier than in the untreated lot.

Lots IV, V, VI, and VII, which received increasingly more short-day treatments, flowered progressively earlier. But there was no strict proportionality between number of short-day cycles and earliness of flowering.

Effect of light duration and intensity on flowering. In most of the previous experiments a 10-hour treatment was given the plants to induce flowering. It is possible that this is not the optimum day-length for flower induction and that other lengths of light serve just as well. To find the effect on flowering of various day-lengths, lots of 45-day-old plants were subjected to six hours of daylight on the one hand and 12 hours of daylight (natural day) on the other. Between the two extremes, other lots were spaced one hour of each other. The treatment was not interrupted until flower emergence.

An incidental lot (Va) was run in conjunction with the 8-hour day lot (V) to find if diffuse light would alter flowering duration.

At the time of writing on June 30, 1955, lot I, which was 177 days old, was still very much in the vegetative stage (table 5). It will be recalled that in the preliminary experiment, the lot planted on January 12, 1953, flowered in 75 days, whereas the lot planted on February 4, 1954, flowered in 281 days. A slight variation in light conditions at this time of the year seems to make the difference between early flowering and very late flowering. Lot II, given the 11-hour day treatment, flowered at 96 days of age after 51 cycles. Lot IV on the 9-hour day treatment flowered after 43 cycles, and lot VII on the 6-hour day treatment, after 48 cycles. These data seem to lend support to Gregory's (1948) concept that a very long, as well as a very short, light period may delay or inhibit flowering.

Lot Va, with 9 hours of diffuse light, flowered after 54 cycles as contrasted with lot V, 8 hours of full sunlight, which flowered after 44 cycles. Apparently, more cycles of diffuse light were needed for the flowering stimulus to build up to a threshold concentration. This stimulus is probably related to, if not identical with, carbohydrates. It is interesting to note that the number of spikelets in lot Va was less than half that in lot V. Also, the grains were half-filled. There was a general tendency for lots V, VI, and VII to produce smaller panicles than lot IV.

TABLE 5.—*Effect of light duration and intensity on flowering* [a]

LOT NUMBER	TIME EXPOSED	LIGHT DURATION	TREATMENT TO FLOWERING	AGE AT FLOWERING
		hours	*cycles*	*days*
I	Natural day	12	no flower after 177 days	
II	6:00 a.m.–5 p.m.	11	51 [b]	96
III	" –4 p.m.	10	44	89
IV	" –3 p.m.	9	43	88
V	" –2 p.m.	8	44	89
VI	" –1 p.m.	7	47	92
VII	" –12 m.	6	48	93
Va	" –2 p.m. (diffuse light)	8	54	99

[a] Seeds planted January 4, 1955; age at start of treatment was 45 days.
[b] Time when 50 per cent of the plants flowered.

Effect of physiologically active substance on flowering. Since flowering is just one aspect of growth, it is probable that this process is affected by growth-promoting substances and growth inhibitors. For information on this point, plants were started in pots on October 28, 1954. They were maintained under lowland conditions like the plants in the previous experiments. When they were 60 days old, they were divided into five lots of eight pots each. Lot I was sprayed with naphthalene acetic acid (NAA), lot II with indole butyric acid (IBA), lot III with indole acetic acid (IAA), and lot IV with maleic hydrazide (MH). Lot V was not treated at all. The sprays were at a concentration of 50 ppm and were applied every other day.

The plants were left in natural day-length. November being in the short-day season of the year, the plants were expected to flower. However, flower-bud initiation did not occur even as late as December 31. Fearing that the lengthening days of January would delay the flowers very much, the writers gave four pots in each lot 10-hour day treatments (6 a.m. to 4 p.m.) beginning on January 1, 1955.

Regardless of the chemicals, the four pots in each lot which received the short-day treatment flowered earlier than the other four pots (table 6). In general the sprayed plants, regardless of the chemical, flowered earlier than the unsprayed plants. In the short-day treatment, those sprayed with naphthalene acetic acid flowered in 89 days; those with indole acetic acid in 90 days; those with indole butyric acid in 91 days; those with maleic hydrazide in 92 days; and

the unsprayed plants in 95 days. The first three compounds are growth promoters, and the fourth one is a growth inhibitor.

TABLE 6.—*Effect of plant hormones on flowering*

LOT NUMBER AND TREATMENT		AGE AT SHORT-DAY TREATMENT	LENGTH OF SHORT-DAY TREATMENT	AGE AT FLOWERING
Ia	NAA [a]	60	29	89
b	[b]			93
IIa	IBA	60	31	91
b				94
IIIa	IAA	60	30	90
b				93
IVa	MH	60	32	92
b				96
Va	Control	60	35	95
b				100

[a] Every other day, sprays at 50 ppm concentration were applied until the leaves were drenched.
[b] Not subjected to short-day treatment.

It could not be ascertained whether or not the differences in age of flowering in the different treatments were significant. The differences, however, were very little, suggesting that these compounds at 50 ppm have little or no effect on flowering.

Upon spraying soybean and Xanthium plants grown under flower-inducing short photoperiods with 500 ppm indole acetic acid and naphthalene acetic acid solutions, Bonner and Thurlow (1949) observed that the production of flower primordia was inhibited. They consequently made the assumption that flowering of plants might possibly be delayed by the external application of auxin since a marked decrease in auxin content of plants at the time of flowering had been demonstrated. The same results were found by Green and Fuller (1948).

Leopold and Thimann (1948) reported that auxin treatments of barley had an inhibitory effect on vegetative buds. However, they further noted that low concentrations which inhibited vegetation definitely increased the number of flower primordia, and high concentrations decreased them.

Rice (1950) suggested that it is more logical to use an anti-auxin or perhaps an auxin-inhibitor to induce flowering. This is partially borne out by the recent finding of Bonner (1951) that application of anti-auxins 2,4-dichloranisole and triiodobenzoic acid to

Xanthium plants kept in long photoperiods caused the initiation of flower buds.

Galston (1947) found that the flowering response of Peking and Biloxi soybean plants was augmented by the application of triiodobenzoic acid.

The only plant which has almost consistently flowered after the application of growth hormones is the pineapple (Traub *et al.*, 1939).

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COLLEGE AND ALUMNI NOTES

Prof. A. J. Sims of the Extension Teaching and Publications Office recently completed an eight-day assignment in Japan to study and appraise the effectiveness of existing types of Japanese agricultural and home economics extension publications. He also conducted workshops for writers of extension publications, farm magazine editors, and other agricultural information personnel.

A rash of new baby boys broke out on the campus the past two months: Philip Richard Flores, Evello T. Castillo, Francisco R. Santos, Roel F. Campos, and Rolf Rudolf Oppenfield. The next-generation agriculturists and their mothers are doing well.

"Land Reforms in the Philippines" is the subject of a series of lectures conducted by the Agricultural Tenancy Commission for Agricultural Economics 199. The Tuesday seminars at the Agricultural Economics Lecture Hall have had the following speakers: Dr. Joe R. Motheral, ICA Consultant of the commission; Col. Guillermo Santos, chairman of the commission; and Mrs. Lydia Mondoñedo, commissioner.

Two engineers of the Department of Agricultural Engineering recently joined the group of young marrieds on the campus. Well-informed sources say that the Dante de Padua-Ludivina Samson and Juan Uy-Josefina Quedding teams date back to Diliman school days.

Demetrio S. Santos, '36, president of the Philippine Association of Agriculturists, delivered the opening address at the organization's convention on May 5-6. The theme of the conference was "Increased and Balanced Agricultural Production Through Science."

The first faculty monthly social of the school year was sponsored by the Departments of Languages and Home Technology on July 7.

For three years a familiar figure on the campus, Prof. Montgomery E. Robinson wound up his duties as Project Leader of the Cornell group and emplaned for the United States on July 2. Dr. Marlin G. Cline of the Department of Soils took over.

Twenty-nine high-yielding Murrah buffaloes swelled the animal husbandry department herd on May 23. They were allocated to the College by the International Cooperation Administration from

its stock of 316 buffaloes purchased for distribution to various government entities in the Philippines.

Acting Dean Francisco O. Santos formally opened the 1955 intramural basketball season on June 23 by tossing the first ball at the opening game between the juniors and sophomores.

Agricultural scholarships were granted this year to Rogelio Bacalzo by the Philippine Junior Chamber of Commerce in memory of the late Joaquin Gonzalez; to Isabelo Alcordo and Edgardo Carlos by the Philippine Packing Corporation; to Fidel Nisperos by the National 4-H Advisory Council of the Philippines; and to Bienvenido A. Juliano by Bailon de la Rama.

Fulbright grantees for 1955-56 are two women graduates of the College who have been on the research and instructional staff for over a year. Concepcion L. Valera, *cum laude,* graduate research fellow in the Department of Soils, will do graduate studies on soil chemistry at Cornell University, which has given her an assistantship. Maria Salome E. del Rosario, instructor in plant pathology, holds a Presidential Fellowship for graduate work in plant pathology from the Oklahoma Agricultural and Mechanical College. Orientation training will be in New York for Miss Valera and in Lawrence, Kansas, for Miss del Rosario.

The leaping enrollment at the College brought new faces to the different units. Among them are the following:

Department of Agronomy—Apolonio C. Anunciado, Victorino Y. de Dios, Vicente G. Dosado, Sotero S. Salac, Democrito K. Talian, Ramon V. Valmayor, assistant instructors;

Department of Animal Husbandry—Perfecto Hebron and Antonio S. Achacoso, assistant instructors; Felicitas L. Cortes and Socorro Olaivar, research assistants;

Department of Agricultural Botany—Concepcion Aricayos, Francisco Manuel, Angelito del Mundo, Ludivina Samson de Padua, assistant instructors;

Department of Agricultural Chemistry—Teresita B. Africa, assistant instructor; Erlinda T. Tucay, research assistant; Sylvia R. Arnaldo, research fellow;

Department of Agricultural Education—Luz E. Gabertan and Justina Mabesa, assistant instructors; Ramon Ibarbia, research assistant;

Department of Agricultural Engineering—Emilio R. Fernandez, Jr., Amador P. Jimenez, Henry F. Magalit, Agustin N. Ramos, Jr., Rainerio O. Reyes, Angelito R. Sandoval, Jesusa T. Taleon, assistant instructors; Bernardo G. Valdez, research assistant;

Department of Entomology—Wilhelmina A. Fernandez, instructor; Feliciano B. Calora, Rodolfo M. Ela, Venus C. Joaquin, Rosalina I. Mercado, Benedicto Selirio, assistant instructors; Bonifacio Alburo and Epitacio P. Punzalan, research assistants;

Division of Farm Management—Virgilio R. Carangal, assistant farm superintendent;

Department of Home Technology—Gloria Elauria and Adela G. Santos, assistant instructors;

Department of Languages—Paz Maria E. Sabater, instructor; Macaria Amurao-Agtane, Edgardo de la Cruz, Ernesto H. Cubar, Pacifico Espanto, Pacita B. Fernandez, Gloria Salandanan, Elenita S. Sayoc, and Isabel Yumol, assistant instructors;

Department of Military Science and Tactics—Antonio B. Gicana, assistant instructor;

Department of Physical Education—Florencia Navales, instructor;

Department of Plant Pathology—Romeo V. Alicbusan, Vivencio L. Quiñon, Benicio A. Revilla, Bienvenido P. Tamayo, assistant instructors;

Rural High School—Justina O. Mabesa, assistant instructor;

Department of Soils— Bonifacio A. Azucena, Jr. and Cezar P. Mamaril, assistant instructors.

Vito F. del Fierro, Jr., '52, is on a UNESCO fellowship at the Kasetsart University in Bangkhen, Bangkok, Thailand.